*A star (*) indicates that the Abstract deals with Apparatus and Instruments.*

## MARCH, 1938.

# GENERAL PHYSICS.

### ADSORPTION (see Surface Properties).

### ATOMIC AND MOLECULAR STRUCTURE.

**900. Variation of Light Atomic Nuclei from the Hartree Model. B. O. Grönblom.** *Soc. Scien. Fennica, Acta,* 2. 9. [28 *pp.*], 1937. *In German.*—A comprehensive paper deals theoretically with the structure of the nuclei $^{4}_{2}$He and $^{16}_{8}$O. A determination of the nuclear structures depends not so much on the special form of the laws of nuclear force but on the general properties of the forces as far as they are known. These properties are discussed and summarised. The method of calculating the binding energies of the nuclei is outlined. This binding energy for hard atomic nuclei is approximately proportional to the number of particles. Several arguments against the Hartree model are given. The theory of the method of calculating the perturbation for both $^{4}_{2}$He and $^{16}_{8}$O is given. The various approximate results are plotted and discussed, along with the results for infinitely hard nuclei and the exact result for deuterons. G. O. B.

**901. Atomic Physics. C. H. Collie.** *Phys. Soc., Reports,* 4. *pp.* 173–197, 1938.—Progress review.

**902. Theory of Nuclear Reactions. L. Goldstein.** *Comptes Rendus,* 206. *pp.* 42–44, *Jan.* 4, 1938.—The protons and neutrons of the nucleus are regarded as forming a degenerate " gas " occupying the whole volume of the nucleus, and the probability of any of them attaining sufficient energy to overcome the cohesive forces retaining them within that volume, and so escaping from the nucleus, is calculated. C. A. S.

**903. Dielectric Polarisation and Form of $CO_2$ Molecule. K. L. Ramaswamy.** *Indian Acad. Sci., Proc.* 6*A. pp.* 301–311, *Dec.*, 1937.—Accurate measurements of the dielectric coefficient of $CO_2$ have been made at eight different temperatures from + 20° to + 210° C. The value of polarisation is constant within the limits of experimental error, indicating that the gas is non-polar within the temperature range employed. The results of the present investigations do not support the possibility of a bent structure for the molecule of $CO_2$ above 145° C., as postulated by Ibbs and Wakeman from their measurements on thermal diffusion and viscosity [see Abstract 2286 (1932)]. Incidentally, accurate measurements of the dielectric coefficients of $CH_4$ have been made at four different temperatures in the range from + 25° to + 190° C. AUTHOR.

**904. Molecular Structure of Germanium Bromide. M. Rouault.** *Comptes Rendus,* 206. *pp.* 51–52, *Jan.* 4, 1938.—Using a specially designed electron-diffraction apparatus, measurements indicate a tetrahedral structure for $GeBr_4$, with Ge — Br = 2·32 Å, and Br — Br = 3·79 Å. C. A. S.

**905. Electronic Structure of Polyenes and Aromatic Molecules. Part IV. C. A. Coulson. Part V. G. W. Wheland. Part VI. W. G. Penney and G. J. Kynch.** *Roy. Soc., Proc.* 164*A. pp.* 383–420, *Feb.* 4, 1938.—In Part IV general formulæ are given for the lengths of the links

of free radicals and molecules of chain-form $C_{2n+1}H_{2n+3}$. It is shown that in these chains the effect of resonance is to remove some of the characteristic properties of alternate single and double bonds. Calculations have been made of the energies of these radicals in certain particular cases, and the effect of resonance has been estimated. Part V: The valence-bond and the molecular orbital treatments of cyclobutadiene disagree in two respects. The first treatment predicts that the resonance energy should be about $-1{\cdot}5$ eV and that the ground state should be a singlet; the second, on the other hand, predicts that the resonance energy should be zero and that the ground state should be a triplet. The first of these discrepancies is found to be a result of the fact that the molecular orbital treatment neglects the resonance between the two Kekulé-like structures. The second discrepancy is found to be due to the effect of ionic structures, which are not taken into account in the valence-bond treatment, but which are made important in the molecular orbital treatment. The resonance among these ionic structures is of such a nature as to stabilise the triplet considerably more than the singlet state. A similar discussion of benzene shows that the ionic structures contribute to the stability of the singlet ground state in essentially the same way as to the lowest triplet state of cyclobutadiene. In Part VI calculations are made to find the internuclear distances in molecules containing the system $C = C - C_6H_5$. The length obtained for the double bond is the same as that in ethylene; the ring distances are the same as those in benzene; but the "single" bond has the peculiarly short length 1·44 Å. Similarly, in the system $C \equiv C - C_6H_5$, the triple bond has a normal length 1·20 Å, the ring distances are the same as in benzene, but the "single" bond has a length of 1·41 Å. Measurements by Robertson and Woodward on stilbene and tolane agree exactly with these results. AUTHORS.

**906. Molecular Structures of Ketene and Thiophosphoryl Chloride. J. Y. Beach and D. P. Stevenson.** *J. Chem. Phys.* 6. *pp.* 75–80, *Feb.*, 1938.—The structures of the gas molecules of ketene and thiophosphoryl chloride have been determined by the diffraction of 57 kV electrons. The interpretation of the photographs was made by the visual method in conjunction with the radial distribution method. The results for ketene are: C–C distance $1{\cdot}35 \pm 0{\cdot}02$ Å, and C–O distance $1{\cdot}17 \pm 0{\cdot}02$ Å. The C–H distance was assumed to be 1·07 Å. The results for thiophosphoryl chloride are: P–Cl distance $2{\cdot}01 \pm 0{\cdot}02$ Å, P–S distance $1{\cdot}94 \pm 0{\cdot}03$ Å, and the Cl-P-Cl angle $107 \pm 3°$. The results are discussed in terms of covalent radii and the resonance of molecules among several electronic structures. AUTHORS.

**907. Interatomic Distances in Simple Polyatomic Molecules. G. B. B. M. Sutherland.** *Faraday Soc., Trans.* 34. *pp.* 325–335, *Feb.*, 1938.—The spectroscopic data available on the methyl halides have been critically re-examined in order to get the best possible estimates of the interatomic distances, but more particularly of the carbon-halogen distances. The values arrived at are C–F = $1{\cdot}385 \pm 0{\cdot}004$ Å, C–Cl = $1{\cdot}66 \pm 0{\cdot}05$ Å, C–Br = $1{\cdot}88 \pm 0{\cdot}08$ Å, C–I = $2{\cdot}07 \pm 0{\cdot}16$ Å; these appear to be definitely lower than the values obtained by the method of electron diffraction. A comparison of the force constants characteristic of the carbon-halogen bond in these molecules with the corresponding constants in the carbon tetrahalides indicates that the carbon–halogen distance increases in going from the methyl halide to the corresponding tetrahalide. This again disagrees with the results of electron diffraction which give either

a decrease or no change. The dimensions of the $CH_3$ group appear to vary extremely little in going from $CH_3F$ to $CH_3I$, although absolute constancy of the group cannot be established until the spectra of the methyl deuterides have been examined. AUTHOR.

**908. X-Ray Analysis and Application of Fourier Series Methods to Molecular Structures. J. M. Robertson.** *Phys. Soc., Reports,* 4. *pp.* 332–367, 1938.—Progress review.

**909. Atomic Weight of Lead and Pb/U Ratio in St. Joaquimsthal Pitchblende. G. P. Baxter and W. M. Kelley.** *Am. Chem. Soc., J.* 60. *pp.* 62–64, *Jan.*, 1938.—The atomic weight of a specimen of Pb from St. Joaquimsthal pitchblende has been found to be 206·50. The percentage of common lead calculated from the atomic weight is 41.3. This agrees with the percentage found by A. O. Nier from isotopic analysis. The percentages of Pb and U in the mineral are found to be 3·22 and 60·24, respectively. The percentage of uranium lead is calculated to be 1·89 and the Pb/U ratio 0·0314. The approximate age of the mineral appears to be 239 million years, and the age by the logarithmic formula 234 million years. AUTHORS.

**910. Formation of Mercury Molecules. Part II. F. L. Arnot and M. B. M'Ewen.** *Roy. Soc., Proc.* 165*A*. *pp.* 133–147, *March* 18, 1938.—An investigation of the formation of ionised $Hg_2$ molecules has been made by the balanced space-charge method. The results obtained in this work, together with those previously obtained with a mass spectrograph by Arnot and Milligan, show that molecular ions are formed by the three process (1) $Hg'\ (2\ ^3P_1) + Hg'\ (2\ ^3P_0) \rightarrow Hg_2^+ + \epsilon$; (2) $Hg'\ (4\ ^1P_1) + Hg \rightarrow Hg_2^+ + \epsilon$; (3) $Hg'\ (5\ ^3P) + Hg \rightarrow Hg_2^+ + \epsilon$. Ions formed by each of these processes have been detected. The appearance potentials for these three processes are respectively 4·86 and 9·722 V for (1) and (2) and 9·792, 9·796 and 9·817 V for the triplet process (3). Ions formed by process (1) which requires a collision between two excited atoms were detected at a vapour pressure of 0·1 mm. of Hg at 0° C. Ions formed by processes (2) and (3) which involve a collision between one excited atom and a normal atom were detected at pressures of the order of 0·01 mm. The ionisation potential of the mercuty molecule lies between $9·52 + D$ and $9·32 + D$, where $D$ is the work of dissociation of the normal molecule. Using Winan's (1931) value for $D$ the limits are 9·67 and 9·47 V. Excited atoms in states other than P states do not apparently form ionised molecules by attachment even though they have more than sufficient energy to do so. [For Part I see Abstract 380 (1936).]

*See also* Abstracts 999, 1166, 1198, 1261, 1291.

## COLLOIDS.

**911. Dynamic Birefringence of Colloids (Maxwell Effect). Influence of Solvent. C. Sadron.** *J. de Physique et le Radium,* 8. *pp.* 481–488, *Dec.*, 1937.—The birefringence of a suspension of oriented particles whose form is that of elongated ellipsoids of revolution is calculated by Langevin's method. It depends both on the optical anisotropy of the particles and on their geometrical anisotropy. The calculation is applied to flow birefringence, and the results are in good agreement with experimental observations for polystyrenes and nitrocelluloses. The relationship of these observations to the shape and structure of dissolved particles is discussed. C. B. A.

**912. Polarisation of Light Transmitted by Colloidal Solutions. A. Boutaric and L. Bernard.** *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 284–290, *Dec.* 31, 1937.—The degree of polarisation of light transmitted through $As_2S_3$,$Fe(OH)_3$, and clay sols during the process of coagulation by addition of KCl or $BaCl_2$ has been investigated. Most colloidal solutions which do not normally polarise light acquire this property during coagulation. Certain sols are able to polarise light before coagulation, but the degree of polarisation is increased during coagulation. The limit of polarisation reached during coagulation is determined by the anisotropy and state of aggregation of the coagulated micelles. A. J. M.

**913. Absorption and Scattering of Light in Hydrophobic Colloids. Part II. F. B. Gribnau.** *Kolloids Zeits.* 82. *pp.* 15–23, *Jan.*, 1938.—Continuing previous work [see Abstract 619 (1937)] the author tests experimentally the Mie theory of the optical behaviour of turbid media. With sols of Au, Se and mastic satisfactory agreement is found between calculated and observed extinction coefficients, especially for the highly dispersed systems. Given sols of Au or Se can be reproduced. In the solution of Se in hydrazine hydrate chemical reaction takes place and the result is a molecular dispersion. From comparison of the extinction of colloidal and molecular dispersions of Se it appears probable that the absorption of light varies continuously from the one to the other. L. A. W.

**914. Isothermal and Reversible Immobilisation of Particles in Thixotropic Sols. W. Heller and G. Quimfe.** *Comptes Rendus*, 205. *pp.* 1152–1154, *Dec.* 6, 1937.—The dynamics of thixotropy are usually studied in terms of the time required for setting to occur, after a gel has been liquefied by mechanical working. As a criterion of setting the authors propose the cessation of Brownian movement. Previous workers have employed the Tyndall effect to determine this point. It is now shown that with those sols which exhibit magnetic birefringence, the changes in this property with time are easily studied ; setting is considered to have occurred when the birefringence ceases (particles no longer free to orient themselves on applying the magnetic field). Further internal changes occur, however, after this point has been reached. [See following Abstract.] L. V. C.

**915. Effect of Orientation of Non-Spherical Colloidal Particles on their Velocity of Aggregation. W. Heller and G. Quimfe.** *Comptes Rendus*, 205. *pp.* 1394–1396, *Dec.* 27, 1937.—If the particles in a sol are non-spherical the number ready to aggregate and therefore the rate of coagulation should be increased by their orientation [see Abstract 5168 (1937)]. This is shown probably to be the case by comparing the times of coagulation ($t$) of a thixotropic solution of $\alpha$-FeOOH containing 5·44% Fe, when oriented by a magnetic field and when not so oriented. In a field of 27600 gauss $t$ for such a sol was 19 min. as compared with 31 min. when the field was absent. The name *tactocatalytic* is proposed for this accelerating effect of orientation, and at least partially explains rheopexy. [See Abstract 3254 (1935) and preceding Abstract.] C. A. S.

***916. Sedimentation Rate and Equilibrium in Centrifuges and Opaque Ultra-Centrifuges. J. W. McBain.** *Science*, 87. *pp.* 93–94, *Jan.* 28, 1938.—A review of methods using centrifuges for determining particle size and molecular weights. The Bechhold-Schlesinger convection centrifuge is referred to, and the methods involving immobilisation of the liquid by means of jellies, and by mechanical means, such as baffles, are described. A. J. M.

**917. Dilatancy and its Relation to Thixotropy. H. Freundlich and H. L. Röder.** *Faraday Soc., Trans.* 34. *pp.* 308–316, *Feb.*, 1938.—The dilatancy of aqueous suspensions of quartz and starch was quantitatively investigated by finding the speed of a sphere pulled through the mass with varying shearing stresses. The suspensions acted as normal viscous fluids at low rate of shear, but with increasing rate the resistance to motion became disproportionately greater, and the speed of the sphere reaches a limiting value. Dilatancy was observed only with a concentration range of the suspensions of 42–45%. This does not agree with the view that dilatancy is due to a change from close to loose packing, and an alternative theory is put forward. Colloidal systems were also prepared which showed behaviour similar to dilatancy. The nature of the suspension medium has a marked effect on the phenomenon. Suspensions of quartz or starch in polar liquids ($H_2O$, EtOH, glycerol) show dilatancy, but those in non-polar liquids ($C_6H_6$, $CCl_4$, etc.) were thixotropic. A. J. M.

**918. Electrochemistry of Platinum Sols. Part III. N. A. Balaschowa and N. Bach.** *Acta Physicochimica*, 7. 6. *pp.* 899–914, 1937. *In English.*—The state of the surface of Pt sols in various gaseous atmospheres corresponds exactly to the state of the surface of the Pt-gas electrode. On careful oxidation of negative $H_2$-Pt-sols positive $O_2$-Pt-sols are obtained which, on further oxidation, pass into negative oxidised sols. The state of the surface may be judged by the adsorption of acid. The absolute value of the kataphoretic velocity of positive $O_2$-Pt-sols is of the same order as that of negative sols. It was not possible to preserve the positive sols without change for long intervals of time. Oxidation did not stop at a definite state of the surface but continued even on saturating the sol with pure $N_2$, until the surface became again negative. Oxidation at various rates (the extreme rates being in the ratio 1 : 25) has shown that the sol particles are not uniform and oxidise with widely differing velocities. The measurement of the kataphoretic velocity of $H_2$-Pt-sols has shown that in solutions of HCl the $\zeta$-potential steadily decreases with increase in concentration, whilst in KOH solutions it first increases and then decreases. This course of the curves confirms the parallelism between the $\epsilon$-potential and the $\zeta$-potential. [For Part II see Abstract 4268 (1937).] AUTHORS.

**919. Action of Hydrochloric Acid on Colloidal Silicic Acid. V. N. Krestinskaja and N. E. Natanson.** *Acta Physicochimica*, 7. 6. *pp.* 915–936, 1937. *In English.*—It is found that only concentrated solutions of HCl can produce the coagulation of a $SiO_2$-sol, but a strong stabilising effect of HCl produced on sols coagulated by a saturated NaCl solution has been observed in a number of $SiO_2$-sols. An absence of peptising power of HCl has been ascertained with a number of $SiO_2$-gels. Experiments on transference and electrophoresis have revealed no reversal of charge in a number of $SiO_2$-sols under the action of HCl; only a total loss of charge of the micelles has been observed. Experiments on the dialysis of mixtures—sol with water and sol with HCl at different concentrations—have shown that HCl does not promote the disintegration of the micelles into separate molecules. It is concluded that the cause of the stabilising action of HCl on $SiO_2$-sols is the strengthening of the hydrophilic properties of the sols. The variation of the relative viscosity of sols has been studied within the limits of pH values of from $-0{\cdot}40$ to $12{\cdot}95$, and it is found that small amounts of alkali increase whereas small amounts of HCl reduce the viscosity. The region of viscosity decrease by HCl coincides with the region of stabilisation of the sol,

whilst the beginning of the stabilisation region coincides with the total loss of charge in the sol. H. H. Ho.

**920. Ratio of Electroosmotic to Electrophoretic Mobility. H. L. White and L. Fourt.** *J. Phys. Chem.* 42. *pp.* 29–37, *Jan.*, 1938.—Evidence is presented that 0·01% gelatin is sufficient to coat completely the suspended particles and cell wall, giving characteristic protein surfaces; the authors' former finding is confirmed [see Abstract 2807 (1935)] that here the ratio is greater than unity in KCl solutions of concentration $10^{-3}$ *M* or lower. Evidence is presented that the ratio of electroosmotic to electrophoretic mobility is dependent on the concentration of gelatin as well as of added electrolyte. The effect of added gelatin is qualitatively the same as that of added electrolyte and is apparently due to its zwitter-ion concentration. AUTHORS.

**921. Electrophoresis of Hydrocarbons and Simple Derivatives as a Function of pH. J. C. Carruthers.** *Faraday Soc., Trans.* 34. *pp.* 300–307, *Feb.*, 1938.—The electrophoretic mobilities of various purified organic substances have been determined in the presence of 0·01 *N* Na ion over the range pH 2 to 12. The difference in mobility produced by the change of state from solid to liquid is ascribed to the difference in surface densities of the molecules produced by the change of state. Numerical values have been ascribed to the mobility effects produced by the introduction of various groups into the chain end of a paraffin, and these values are related to the residual charges on the end groups. AUTHOR.

**922. Liesegang Rings with Uric Acid. H. Knöll.** *Kolloid Zeits.* 82. *pp.* 76–79, *Jan.*, 1938.—The conditions for producing Liesegang rings with uric acid in gelatin are examined. The rings are visible only under the microscope, and are distorted by crystal formation. They may be fixed by treatment with MeOH, and drying *in vacuo* over conc. $H_2SO_4$. A. J. M.

**923. Differential Equation of Ultracentrifuging. S. Oka.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 1094–1104, *Dec.*, 1937. *In English.*—The solution of Lamm's differential equation of ultracentrifuging [see Abstract 824 (1930)] is given, satisfying certain boundary and initial conditions. The applicability of the solution is checked by numerical calculations. AUTHOR.

**924. Two Possible Orientations of Colloidal Gœthite in the Magnetic Field. W. Heller and G. Quimfe.** *Comptes Rendus*, 206. *pp.* 64–66, *Jan.* 4, 1938.—Experimental work is described to decide whether the change of sign of birefringence and of magnetic dichroism which sols of α-FeOOH exhibit with elevation of temperature are due to changes of particle orientation. Three series of experiments of an entirely different character have been carried out on a single sol, gœthite, whose magneto-optical anisotropy changes sign towards 25°. From the results obtained it followed that change of sign was due to orientation changes, while the optical anisotropy only varied slightly. Other explanations are discussed and shown to be invalid. H. H. Ho.

*See also* Abstract 1259, and
780B. Properties, Formation and Measurement of Finely Divided Powders. A. Winkel.

## CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

**925. X-Ray Scattering by Crystals with Variable Lamellar Structure. L. Landau.** *Phys. Zeits. d. Sowjetunion*, 12. 5. *pp.* 579–585, 1937. *In English.*—A formula is derived for the distribution of intensities in X-ray lines on scattering from crystals with variable lamellar structure.

The shape of the spots in a Laue-diagram and of the lines in a rotational pattern are examined. AUTHOR.

**926. Evaluation of Hexagonal Structure Factors. C. A. Beevers and H. Lipson.** *Phys. Soc., Proc.* 50. *pp.* 275–282, *March* 1, 1938.—The formulæ $\Sigma \cos h\alpha \cdot \cos (k-i)\beta$, $\Sigma \cos h\alpha . \sin (k-i)\beta$, $\Sigma \sin h\alpha . \cos (k-i)\beta$, $\Sigma \sin h\alpha . \sin (k-i)\beta$, which are very useful in calculating the intensities of X-ray reflection from hexagonal crystals have been tabulated for various values of $h$ and $k$. In these formulæ $\alpha$ and $\beta$ are the semi-sum and semi-difference of the hexagonal coordinates $x$ and $y$. AUTHORS.

**927. Electron Energy Bands in Copper and Silver. S. R. Tibbs.** *Cambridge Phil. Soc., Proc.* 24. *pp.* 89–99, *Jan.*, 1938.—A theoretical investigation by use of wave functions with suitable boundary conditions, Hartree's field for the positive ion being assumed. The author suggests that the wave function $\psi = S + A\,(xy + yz + zx)d/r^2$, with a node in the 111 direction midway between the 111 planes, and with its derivative vanishing midway between its nearest neighbours at right angles to the 111 direction, gives a better approximation. D. R. H.

**928. Order and Disorder in Binary Solid Solutions. J. G. Kirkwood.** *J. Chem. Phys.* 6. *pp.* 70–75, *Feb.*, 1938.—A theory of order and disorder in solid solutions, based upon the direct evaluation of the crystalline partition function, is described. As in the theory of Bethe, the fluctuation in energy within states of a fixed degree of order, is taken into account. The method promises to be of use in the study of other cooperative phenomena. AUTHOR.

**929. Grain-Like Structure of Solids. W. H. Bragg.** *Roy. Soc., Proc.* 163*A*. *pp.* 472–477, *Dec.* 7, 1937. *Nature*, 140. *pp.* 954–956, *Dec.* 4, 1937.—Magnitudes which are too small to examine in detail in the microscope but too large to be measured by X-ray methods are of considerable interest. Their behaviour presents many problems, the solutions of which are of great importance. Such magnitudes occur in one metallurgical field; while the X-ray methods determine the details of the crystal structure of iron and its alloys with accuracy, this information is insufficient for the prediction of the behaviour of a specimen of steel. Metallurgical theory favours the idea that a metal or alloy contains minute groups of atoms, sometimes called crystallites, since the arrangement of the atoms in each one is perfectly regular. Work on fatigue in metals indicates that fracture occurs in any one region when the break up into crystallites is complete. These properties therefore play an important part in engineering problems. Examination of cellulose fibres seems to show that they are built up of lesser fibres which again consist of ellipsoidal objects of dimensions $1{\cdot}5 - 1{\cdot}1\,\mu$. Each of the latter may contain many millions of cellulose chains. The positions of the atoms in clays have been determined by X-ray methods but the remarkable properties depend on the behaviour of the larger flake-like aggregates of colloidal dimensions. In dielectrics, too, time brings about rearrangements, hastened by the electric tensions to which the material is subjected. C. J. B. C.

**930. X-Ray Examination of System Mn-P. O. Årstad and H. Nowotny.** *Zeits. f. phys. Chem.* 38. *Abt.B.* 5. *pp.* 356–358, 1937.—Mn and red P in varying proportions (0-45·5% P) were melted together in a closed quartz tube. The X-ray results are completely explicable on the assumption of the formation of MnP, $Mn_2P$ and $Mn_3P$, which show no solvent power for Mn or P. There was no indication of $Mn_4P$, $Mn_5P_2$, or $Mn_3P_2$. $Mn_2P$ and $Mn_3P$ crystallise together, $Mn_3P$ crystals being oriented in

definite fashion in the $Mn_2P$ crystal. $Mn_3P$ has $a$ 9·160, $c$ 4·599 Å with 8 molecules in the unit cell; space group $S_4^2$; it is isomorphous with $Fe_3P$. Similar isomorphous phases were found in the system Cr-P and Ni-P. $Cr_3P$ has $a$ $9 \cdot 12_6$, $c$ $4 \cdot 56_0$; $Ni_3P$ $a$ $8 \cdot 91_7$, $c$ $4 \cdot 39_0$. C. A. S.

**931. Nature of Intermetallic Compounds of Type $Mg_2Sn$. W. Hume-Rothery and G. V. Raynor.** *Phil. Mag.* 25. *pp.* 335–339, *Feb.*, 1938.—Mg-Sn alloys containing approximately 2·3% Al or 2% In, are melted in $Al_2O_3$ crucibles under flux and drastically chill-cast in 3/8 in. holes in a Cu block. After annealing for a few weeks at 176° and 186° C., respectively, the alloys are found, on etching with very dilute alcoholic $HNO_3$, to be almost completely single phase; by chemical analysis the electron ratio is found to be very near the value 8/3. Al or In cannot enter appreciably into the $Mg_2Sn$ lattice, notwithstanding the favourable size-factor. This is markedly different from the behaviour of electron compounds in Cu- and Ag- alloys. The structures of $Mg_2Si$, $Mg_2Ge$, $Mg_2Sn$ and $Mg_2$ Pb (anti-isomorphous with $CaF_2$), of $Mg_3P_2$ and $Mg_3As_2$ (anti-isomorphous with $Sc_2O_3$), and of $Mg_3Sb_2$ and $Mg_3Bi_2$ (anti-isomorphous with $La_2O_3$) suggest that they may be regarded as normal valency compounds of weakly electronegative elements, rather than as electron compounds, as suggested by Mott and Jones. D. R. H.

**932. Structure of Compounds of Rare Earths with Bismuth. A. Iandelli and E. Botti.** *Accad. Lincei, Atti,* 26. *pp.* 233–238, *Oct.*, 1937.—A continuation of previous investigations [see Abstract 4813 (1937)]. The results of spectrographic examination by the method of powders are given, and the reticular constants of the components as well as the interatomic distances for structures of the type NaCl. J. J. S.

**933. Structure of Ammonium Chlorobromoiodide. R. C. L. Mooney.** *Zeits. f. Krist.* 98. 4. *pp.* 324–333, 1937. *In English.*—$NH_4BrICl$ crystals were prepared by the method given for RbBrICl; they were found to be isomorphous with this salt, and only slightly less stable. The crystal structure was determined by X-rays, the single crystal oscillation method being used. The cell size is given by: $a = 6 \cdot 13$; $b = 8 \cdot 50$; $c = 9 \cdot 94$ Å. The calculated density is 3·32 gm./cc. The space group is $V_h^{16}$ ($Pmcn$). The atoms are all lying in the reflection planes, and the structure is determined by eight parameters. The parameters were determined by intensity considerations alone. The three halogen atoms form a monovalent anion group, which is strictly linear. Iodine is the central atom. The I-Cl distance is 2·38 Å, and the I-Br distance is 2·50 Å. $NH_4$ is surrounded by eight halogen atoms; four Cl atoms at an average distance of 3·35 Å, and four Br atoms at an average distance of 3·56 Å. [See also Abstract 956 (1935).] AUTHOR.

**934. Structure of Sulphur. J. J. Trillat and S. Oketani.** *Zeits. f. Krist.* 98. 4. *pp.* 334–343, 1937. *In French.*—The method of electron diffraction is applied to the study of the structure of S, using thin films prepared by the evaporation of a solution of S in $CS_2$ on the surface of water. The diffraction diagrams lead to values of the three parameters, $a = 5 \cdot 2$, $b = 6 \cdot 4$ and $c = 12 \cdot 2$ Å, in agreement with Bragg's data. It is possible to follow the progressive passage from diagrams of a three-dimensional lattice to a two-dimensional lattice, due to the progressive evaporation of the S in the vacuum. Under the influence of the heating produced by electron bombardment, as well as by evaporation, a sudden change in the orientation of the S sometimes occurs. It was not possible to observe the transition from orthorhombic to monoclinic S. C. J. B. C.

**935. X-Ray and Electron-Interference Methods of Determining Molecular Structure of $C(CH_2X)_4$ (X = Cl, Br or I). O. Hassel and L. C. Strömme.** *Zeits. f. phys. Chem.* 38. *Abt. B.* 5. *pp.* 349–355, 1937.—Reexamination of $C(CH_2Br_4)$ and $C(CH_2I)_4$ by X-ray [see Abstract 3118 (1932)] and electron-diffraction [see Abstract 3487 (1934)] methods shows the deductions from both as to the structure to be inadmissible. The unit cell contains at least 48 molecules, and the electron-diffraction results seem to be explicable only by some internal mobility of the molecule. C. A. S.

**936. Structure of Pentaerythritol Tetracetate. T. H. Goodwin and R. Hardy.** *Roy. Soc., Proc.* 164*A*. *pp.* 369–383, *Feb.* 4, 1938.—The crystal structure of pentaerythritol tetracetate has been determined. The molecule has fourfold alternating symmetry, the valencies of the central C atom being inclined to each other at the tetrahedral angle. The remaining valency angles are listed, with the interatomic distances, in a table. They show that the acetate group is planar, as anticipated by chemical theory, and that the length of the C = O bond is 1·38 Å. AUTHORS.

**937. X-Ray Analysis of Dibenzyl Series. Part V. Tolane and the Triple Bond. J. M. Robertson and I. Woodward.** *Roy. Soc., Proc.* 164*A*. *pp.* 436–446, *Feb.* 4, 1938.—The crystal dimensions of tolane are very similar to those of stilbene, and this fact has been used in making a very direct X-ray analysis of the tolane structure, without the use of any model based on the chemistry of the compound. The two central atoms linked by the triple bond are found to be collinear with the end atoms of the benzene rings to which they are joined. The carbon-carbon triple bond distance is 1·19 Å, and for the " single " bond connecting these central atoms to the benzene ring, the unusually small distance of 1·40 Å is obtained. These results are discussed in relation to acetylene and other compounds. As in the stilbene structure, there are four molecules in the unit cell, and two of these make independent contributions to the asymmetric unit of the crystal. The orientations of these two molecules are deduced, and the coordinates of the atoms are given. The minimum intermolecular approach distances are between 3·5 and 3·6 Å for the C atoms. [For Part IV see Abstract 4817 (1937).] AUTHORS.

**938. Structure of Insulin. Part I. D. Crowfoot.** *Roy. Soc., Proc.* 164A. *pp.* 580–602, *Feb.* 18, 1938.—X-ray crystallographic measurements show that insulin crystallises in the rhombohedral system, space group R3. The dimensions of the unit cell are $a = 44·4$ Å, $\alpha = 114°\ 48'$ or, referred to hexagonal axes, $a = 74·8$, $c = 30·9$ Å correct to about 0·5%. The densities of three samples of crystalline insulin have been measured in four different immersion media and show small variations between values of 1·292 and 1·316. From these and the cell dimensions the unit cell molecular weight may be calculated as most probably 39700 (maximum 40800, minimum 38700). The crystals contain water which they lose when dried at 104° in a vacuum and this has been estimated at 5·35%. The molecular weight of protein in the unit cell is hence calculated as 37600 (38900–36000), which is of the order of magnitude though rather less than the molecular weight of insulin found by Svedberg. There is, however, no crystallographic evidence that this weight constitutes a single molecule. The intensities of all the X-ray reflections that could be observed from air-dried single crystals of insulin have been estimated visually and are recorded as terms proportional to $F^2$. From these terms a series of Patterson-Harker Fourier syntheses has been formed which shows

the distribution of the main interatomic distances within the insulin molecule. The patterns correspond to a fairly large scale structure and as such cannot give information on the placing of individual atoms or as to whether the trigonal symmetry shown is necessarily carried to atomic dimensions. The most important interatomic distances that appear are at 10 and 22 Å roughly parallel to the basal plane. It is suggested that these are related to the characteristic X-ray spacings of many proteins both globular and fibrous, and the virus proteins. AUTHOR.

**939. Formation and Orientation of Soft Cross-Twinned Crystals in Anisotropic Liquid Drops of p-Azoxyanisole. P. Gaubert.** *Comptes Rendus*, 206. *pp.* 62–64, *Jan.* 4, 1938.—The present study [see also Abstract 427 (1938)] is that of the optical properties of very small anisotropic drops of p-azoxyanisole deposited by sublimation on a sheet of muscovite mica. The latter proved to be a better material for the purpose than glass for the drop display. The drops were homogeneous with optic axis orientated according to directions indicated by Mauguin and Grandjean in the surfaces produced between two cleavages of this mica; sometimes the optic axis coincides with the axis of symmetry of the muscovite. The observations vary with the temperature and size of the drops and the author gives a detailed description of the phenomena. The existence of these twinned crystals is ascribed to an impurity in the azoxyanisole which is soluble in the isotropic liquid but much less so in the liquid crystal.

H. H. Ho.

**940. Theory of Twin Formation. Part III. I. Schaacke.** *Zeits. f. Krist.* 98. 4. *pp.* 281–298, 1937.—In previous papers [see Abstract 433 (1938)] the author studied the relation between lattice geometry and the theory of numbers in twinned crystals and derived formulæ depending on this relation which could be applied to particular cases of twinning. These formulæ are now applied to real cases of twin-formation, *viz.*, fluorspar and iron pyrites. All the literature referred to in this and the two earlier papers is listed at the end of the present paper. J. I.

**941. Parallel Growths. L. Royer.** *Comptes Rendus*, 205. *pp.* 1418–1420, *Dec.* 27, 1937.—This is a continuation of the work of W. Heintze [see Abstract 4303 (1937)] on the regular growth of certain alkali halides on sodium nitrate and calcite crystals. All these present experiments were carried out on freshly cleaved (100) faces of calcite and the crystallisation of the halides took place from alcoholic solutions saturated at about 90° C. The materials studied are:—NaBr, NaI, KCl, KBr, RbCl, RbBr, and KI with which the growth is such that the cube face of the halide is parallel to the (100) face of the calcite and the edge [100] of the cube parallel to the [100] or [010] edge of the calcite. Contrary to Heintze he does not find growth in the "diagonal" position, *i.e.*, where the (110) face of the halide coincides with the rhombohedral face. With NaCl only a portion of the crystals show any special orientation, whilst with $NH_4I$ and RbI there are no oriented crystals at all. The theoretical interpretation of these facts is also discussed. G. G.

***942. Rapid and Accurate Measurement of Line Positions on X-Ray Diffraction Films with the Aid of a Kathode-Ray Oscillograph. H. Tatel and R. Hultgren.** *Rev. Sci. Instruments*, 9. *pp.* 47–50, *Feb.*, 1938.—An apparatus containing a kathode-ray oscillograph has been developed for the measurement of positions of X-ray diffraction lines. A small portion of the film is scanned by a moving slit. A trace of film transmission *versus* distance appears on the screen of the oscillograph.

Lines are easily measured by centring their traces on the screen. Measurements are made very rapidly. Accuracy depends on the sharpness of the line measured. Ordinary back-reflection X-ray lines can be measured to better than 0·02 mm.; sharper lines or points may be located much more accurately. The apparatus is compact and has no parts easily damaged. The cost is less than for a recording photo-densitometer. It can, no doubt, be used for intensity measurements and for the measurement of spectrographic and other types of lines on photographic plates or films.

AUTHORS.

*See also* Abstracts 1231, 1251, 1277, 1287, 1292, 1334, 1360, 1361.

## DENSITY.

**943. Correction for Adsorption in the Method of Determining Limiting Densities. E. Moles.** *Comptes Rendus*, 205. *pp.* 1391–1393, *Dec.* 27, 1937.—Values of the correction for adsorption of gas on the glass of the containing vessel in determinations of limiting density are given. Such corrections exceed the probable error, and should be determined and applied in each particular case. A. J. M.

*See also* Abstract 959.

## DIFFUSION AND OSMOSIS.

**944. Position Exchange in Metallic Phases. C. Wagner.** *Zeits. f. phys. Chem.* 38. *Abt.B.* 5. *pp.* 325–348, 1937.—The diffusion changes in metallic substitution in mixed crystals is illustrated by the two possible models. They are (1) Exchange of position by neighbouring atoms as a single elementary operation. (2) Deficiency (*Fehlordnung*) diffusion mechanism, such as atoms from the space-lattice positions, or vacant positions. The theory is discussed and experimental evidence based upon the behaviour of a solid solution of 0·03% Au in Pb is given to support the theoretical conclusions. F. J. B.

## ELASTICITY AND PLASTICITY.

**945. Hydrodynamic Analogy for Shearing Stress Distribution in Bending. M. A. Biot.** *J. of Applied Physics*, 9. *pp.* 39–43, *Jan.*, 1938.—It is shown here that the shearing stress distribution in the combined shear and bending is represented with practical accuracy by the distribution of velocity in the flow of a perfect fluid over the area of the cross-section. This flow is produced by a linear distribution of sources above the neutral axis and of sinks below the neutral axis, the intensity of these sources and sinks being proportional to the distance to the neutral axis. For hollow beams the additional condition must be added that the circulation of the velocities is zero around each hole of the cross-section. The analogy which is rigorous for a material of zero Poisson ratio holds within a small correction for the general case. AUTHOR.

**946. Relaxation Methods Applied to Engineering Problems. Part II. Basic Theory, with Applications to Surveying and to Electrical Networks, and an Extension to Gyrostatic Systems. A. N. Black and R. V. Southwell.** *Roy. Soc., Proc.* 164*A*. *pp.* 447–467, *Feb.* 18, 1938.—The aim of the present paper is fourfold, *viz.*, (1) to prove that relaxation methods, applied systematically to problems of elastic equilibrium, give solutions which converge steadily towards exact results;

and hence, by analogy, (2) to show that they are applicable to any "minimal" problem, *e.g.*, the adjustment of errors according to the method of least squares; (3) to notice, as particular examples, the adjustment of errors in level or triangulation surveys, and the partition of electric current in non-inductive networks of conductors; and (4) to discuss the more difficult problem of an inductive network carrying alternating current. This serves as a simple illustration of systems which are governed by equations containing "gyrostatic" or "non-energetic" terms, and which for that reason do not present minimal problems of the usual kind. [For Part I see Abstract 3377 (1937).] AUTHORS.

**947. Electrical Analogy as an Auxiliary Method of Photoelasticity. L. Malavard.** *Comptes Rendus*, 206. *pp.* 38–39, *Jan.* 4, 1938.—The possibility, and some indication of the nature, of an electrical method, dependent on determination of equipotential lines under definite conditions, of determining the sum of the two principal stresses in a plane elastic problem (the difference between these stresses being determined photoelastically) is discussed. [See Abstracts 461 (1933) and 2306 (1934).] C. A. S.

**948. Vibrations of a Rotating Rope. A. C. Stevenson.** *Phil. Mag.* 24. *pp.* 293–299, *Aug.*, 1937.—A uniform inextensible string is whirled about a vertical axis, so that it stands out straight from the axis as it moves with a steady motion. Small transverse vibrations are formed on the string, and, neglecting the acceleration due to gravity, the normal functions and the allowable frequencies of these vibrations are determined mathematically. The normal functions of the vertical and horizontal vibrations are the same, but the allowable frequencies have quite different sets of values. Reference is made to several solutions of the problem and errors in these emphasised. It is especially pointed out that the accelerations, relative to rotating axes, depend in general on the rotation of the axes. [See following Abstract]. H. M. B.

**949. Vibrations of a Rotating Rope. C. E. Wright.** *Phil. Mag.* 25. *pp.* 387–388, *Feb.*, 1938.—Three comments are made on the paper by Stevenson [see preceding Abstract]. In the first '$g$' is introduced and $y$ put equal to $Ax/l$, but it is pointed out that no generality is lost when $A = 0$. Secondly, for small oscillations the change in tension from T to $T + T'$, is not necessarily zero, but, for $T'$ zero, the equations reduce to those given in the paper quoted. Thirdly, $T'$ increases in importance with increase of frequency and alters the functions and the frequencies of the small oscillations. H. M. B.

**950. Rate of Viscous Flow of Metals. Part I. Tin. L. C. Tyte.** *Phys. Soc., Proc.* 50. *pp.* 153–175; *Disc.*, 311–312, *March* 1, 1938.—A description is given of a new method of determining the dependence of the rate of viscous flow of metals on the deforming force and its variation with temperature. The measurements were made by means of an optical lever system, and the effect of changes in length produced by possible temperature fluctuations in the furnace were eliminated by the use of the second wire as a support for a lever. It has been found that, for tin, for very small extensions the velocity of viscous flow $v$ can be considered independent of time, but is connected with the stretching load $P$ by an exponential relation for any given temperature and with the absolute temperature $T$ by an exponential relation for any given load. Different relationships of the form $v = \delta e^{\beta^{PT} - \alpha P + \gamma T}$, where $\alpha$, $\beta$, $\gamma$ and $\delta$ are constants, have been obtained, from the {flow, load} curves, for the

rates of flow of tin for glide in one and two directions respectively, and the relations are probably of the type $v = K\{e^{\beta(P+P_0)(T-T_0)} - 1\}$, where $K$, $\beta$, $P_0$ and $T_0$ are constants. Evidence has been obtained in support of the view that the temperature of the allotropic modification from $\beta$ to $\gamma$ tin takes place at 203° C. and not at 161° C. The loads for transition from single to double glide and the breaking loads have been shown to be connected with the corresponding temperatures by a hyperbolic expression. Finally, the behaviour of the tin wire has been shown to be in general agreement with the results obtained from single cyrstals. AUTHOR.

*See also* Abstracts 1254, 1338.

## GRAVITATION.

**951. Gravity Measurement. G. Ising.** *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*A*. *No.* 25. [14 *pp.*], 1937. *In German.*—The errors involved in the static method of measuring gravity are analysed. W. A. R.

*See also* Abstract 1096.

## HYDRODYNAMICS AND AERODYNAMICS.

**952. Two-Dimensional Hydrodynamical Theory of Moving Aerofoils. Part II. R. M. Morris.** *Roy. Soc., Proc.* 164*A*. *pp.* 346–368, *Feb.* 4, 1938.—The discussion of the author's solution of the problem of a general cylinder moving in liquids is generalised to include the effect of a vortex-sheet wake extending backwards in the liquid from a trailing edge. Assuming the wake to be of any shape and to have associated with it a total circulation which is equal and opposite to that of the main circulation round the cylinder, general formulæ are derived for the potential function of the fluid motion and the resultant of the fluid pressures on the cylinder boundary. As steps in the analysis, the solutions of the problem of this general cylinder at rest (*i*) in a uniform stream, (*ii*) in a stream due to an external line vortex parallel to its axis, are solved in detail. The general formulæ are then examined in their approximate form under conditions analogous to those assumed for the particular problems whose solutions are already known, with the object (*i*) of determining the first order effects of camber and thickness and (*ii*) of verifying the approximate theoretical results now used in practice. The result that the camber and thickness have no effect on the force (lift or drag), and only a small effect on the couple when there is acceleration, is verified but in a form which shows the precise conditions governing the degree of approximation involved. The author's result for the lift arising from the circulations, however, differs from that usually given. It is shown that under the usual conditions assumed for the wake, the lift force produced is greater than that produced by the corresponding simple circulation, and that this greater lift is attained without the drag which accompanies it in the simple circulation. [For Part I see Abstract 3384 (1937).] AUTHOR.

**953. Spectrum of Turbulence. G. I. Taylor.** *Roy. Soc., Proc.* 164*A*. *pp.* 476–490, *Feb.* 18, 1938.—It is shown that a definite connection exists between the spectrum of the time variation in wind at a fixed point in a wind stream and the curve of correlation between the wind variations at two fixed points. The spectrum curve and the correlation curve are, in fact, Fourier transforms of one another. As an example of the use of this relationship the spectrum of turbulence in an American wind tunnel was calculated from measurements of correlation by Dryden. In some further experiments Dryden modified this spectrum by inserting a filter circuit and

then measured the correlation with this filter in circuit. The modified spectrum is here calculated from the filter characteristics and the Fourier transform theorem is used to calculate the modified correlation curve. The agreement with Dryden's measurements is very good indeed. The paper ends with some remarks on the bearing of the spectrum measurements on the theory of dissipation of energy in turbulent flow. AUTHOR.

**954. Velocity and Temperature Distributions in the Wake behind a Heated Body of Revolution. S. Goldstein.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 48–67, *Jan.*, 1938.—The velocity and temperature distributions in the wake behind a heated body of revolution are calculated on the vorticity transfer theory of turbulent motion. The equation of the generalised vorticity transfer theory may be simplified in two ways on the analogy of the successful simplification of the corresponding equation for the two-dimensional case. One method gives the same equation as if the turbulence were symmetrical; the other gives the equation of the modified vorticity transfer theory. For the former there is no solution unless Prandtl's "mixing length" $l$ becomes infinite on the axis of symmetry. The equation was integrated with $l \propto r^{-1}$ and $l \propto r^{-3/2}$ across each section; the latter is the only case of a variation with a power of $r$ for which $u$ and $\partial u/\partial r$ vanish together at the edge of the wake. The calculation on the modified vorticity transfer theory was carried out with $l$ constant over a section. The temperature distribution was calculated on each of the foregoing theories, and also without any assumption concerning the kinematic coefficient of turbulent diffusion, from an experimental velocity distribution due to Schlichting. S. G.

**955. Velocity and Temperature Distributions in the Turbulent Wake Behind a Heated Body of Revolution. S. Tomotika.** *Roy. Soc., Proc.* 165*A*. *pp.* 53–64, *March* 18, 1938.—In the present paper, Taylor's modified vorticity transport theory of turbulence [see Abstract 2396 (1937)] is applied to the calculation of the velocity and temperature distributions in the turbulent wake behind a solid of revolution which is placed in a uniform stream such that its axis of revolution is parallel to the direction of the undisturbed velocity. In order to carry out the calculation, it is assumed, with Prandtl, that for sufficiently high Reynolds numbers and at a sufficient distance downstream, there is geometrical and mechanical similarity in different sections of the wake and that the values of the mixing length at corresponding points in different sections are proportional to the breadths of the sections. Also, the isotropy in turbulence is assumed. Assuming the mixing length to be constant over any one section, the distribution of mean velocity is first calculated and the result is compared with the results of Schlichting's and Simmons's observations. The agreement between theory and observations is not quite satisfactory. Next, the distribution of temperature is calculated. However, the comparison of the theoretical result with observations is not made, because no measurements of the distribution of temperature in the wake behind a heated body of revolution have yet been made. AUTHOR.

**956. Application of the Modified Vorticity Transport Theory to the Turbulent Spreading of a Jet of Air. S. Tomotika.** *Roy. Soc., Proc.* 165*A*. *pp.* 65–72, *March* 18, 1938.—The turbulent spreading of a jet of air emerging from a small circular aperture is discussed on the basis of Taylor's modified vorticity transport theory of turbulent motion. Assuming the isotropy in turbulence, the distrubtion of mean axial velocity is calculated for any one section of the jet whose distance from the aperture

is great in comparison with the diameter of the aperture. The calculated curve is compared with the Göttingen measurements and the fairly satisfactory agreement between theory and observations is found, as in the case of Tollmien's calculation on the basis of Prandtl's momentum transport theory. AUTHOR.

**957. Approximate Calculation of the Contraction Coefficient of a Gas Jet. C. Jacob.** *Comptes Rendus*, 205. *pp.* 1365–1367, *Dec.* 27, 1937.—In a previous paper [see Abstract 4523 (1936)] the author has derived an expression for the contraction coefficient of a plane jet of gas issuing from an orifice defined by two infinite straight lines inclined to one another at an angle $2\mu$ $(o < \mu < \pi)$. An approximate value of the coefficient is now derived for slow velocities of flow. The result is applied to discuss the approximation attainable by the theory of Tchapliguine and Demtchenko [see Abstracts 3092 and 3530 (1932)]. J. S. G. T.

***958. Pressure Multiplier for Measuring Small Velocities of Flow. P. Gmelin and R. Riedmiller.** *Zeits. f. techn. Physik*, 18. 11. *pp.* 375–377, 1937.—Single- and double-resistance pressure multipliers customarily employed for measuring small velocities of fluid flow (of the order 1 m./sec.) are described and illustrated. The single type consists of a channel shaped somewhat like a venturi tube; this is inserted in the flow circuit and the drop of pressure between the inlet to the tube and its throat is measured. In the double type a similar but smaller tube is inserted in the single type of tube and the corresponding drop of pressure in the smaller tube is measured. Modifications of both these multipliers are described employing a variation of the venturi tube in which the throat consists of an orifice formed by two truncated opposed conical channels, so arranged that the contraction of the fluid jet after passage through the orifice is independent of the Reynolds number. J. S. G. T.

***959. Effusion-Meter Jet. E. Lehrer and R. Riedmiller.** *Zeits. f. techn. Physik*, 18. 11. *pp.* 378–382, 1937.—Densities of gases, one of which is usually air, are commonly compared by means of an effusion-meter; the technique of the method consists in determining the respective times of efflux of equal volumes of the gases, under similar conditions, through a carefully prepared orifice. As the result of an experimental examination of the efflux of air and $H_2$ through four forms of orifice, the authors specify one, consisting of two oppositely-directed truncated conical orifices in a plate of thickness 0·5 mm., the narrower ends of the cones being opposed to one another, such that the contraction coefficient of the issuing jet is constant to within 0·3% for values of Reynolds number in the range 250–2500. For a Reynolds number equal to 175 the contraction coefficient changes by only about 0·5%. J. S. G. T.

***960. Differential Hot Wire Gaseous Flow Meter. M. J. E. Golay.** *Rev. Sci. Instruments*, 9. *pp.* 55–57, *Feb.*, 1938.—A gaseous flow meter of the hot wire type with a linear response may be obtained by causing the gaseous flow to effect a transfer of heat between two adjacent heated grids. AUTHOR.

*See also* Abstracts 945, 1000, 1076, 1237, 1238, 1239.

## KINETIC THEORY OF MATTER.

**961. Theory of the Brownian Movement. N. Wassmuth.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 6. *pp.* 307–310, 1937. *In German.*—Mathematical. An expression for the initial

distribution of a system of small particles, with $n$ degrees of freedom, and performing small vibrations under the influence of external forces which are harmonic functions of the time, is derived. A. J. M.

*See also* Abstract 1235.

## LENGTH, AREA AND VOLUME.

***962. Rapid Calibration and Correction of Comparator Screws and Photographic Production of Scales. G. R. Harrison.** *Rev. Sci. Instruments*, 9. *pp.* 15–18, *Jan.*, 1938.—An automatic recording and computing comparator [see Abstract 3072 (1935)] has been adapted to the rapid construction of uniform and non-uniform scales on glass by photography. With such a scale, the recording attachment of the comparator can be used to determine the correction curve for a screw in a few minutes. A three dimensional correcting cam may then be shaped to correct the errors found, and fairly cheap screws can thus be made to serve for precision measurements. Details of a method of mounting the screw and the comparator carriage so as to reduce friction are given. J. S. C.

## MASS.

***963. Works Balance for Maximum Load 0·1 mg. W. W. Loebe and R. Kühn.** *Zeits. f. Instrumentenk.* 58. *pp.* 81–84, *Feb.*, 1938.—The balance described in 1933 [see Abstract 1329 (1933)] has been modified to read to 0·0005 mg., with correspondingly reduced maximum load, 0·1 mg. The new balance, like the original, is insensitive to vibration. P. H. B.

## MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

**964. Radiation Integrals** $\int_0^\infty \frac{dx}{x^a(e^x-1)}$. **J. R. Airey.** *Phil. Mag.* 25. *pp.* 273–282, *Feb.*, 1938.

**965. Fiducial Distribution of Several Parameters with Application to a Normal System. I. E. Segal.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 41–47, *Jan.*, 1938.—Fisher's work on fiducial probability [*Annals of Eugenics*, 6. *p.* 391, 1935] is given in somewhat extended form, the case of the fiducial distribution of several independent parameters possessing a sufficient set of statistics being more especially discussed. The fiducial distribution of the parameters is deduced for the case of the normal multi-variate distribution. J. S. G. T.

**966. Significance Tests for Continuous Departures from Suggested Distributions of Chance. H. Jeffreys.** *Roy. Soc., Proc.* 164*A*. *pp.* 307–315, *Feb.* 4, 1938.—A method is developed for testing whether a series of observed frequencies supports a uniform distribution of chance or a suggested departure from it, and is applied to linear departures. A modification applicable to grouped data is given, and a possible way of extending the method to test departures from suggested non-uniform laws of chance is described. AUTHOR.

**967. Limiting Effects of Consideration of Dimensions. E. Fues.** *Zeits. f. Physik*, 107. 9–10. *pp.* 662–668, 1937.—From mathematical considerations it is concluded that considerations of dimensions become more productive the more the foundation in the determination of dimensions is laid on basic quantities, while the useful introduction of new basic quantities has a limit in the natural determination of the problem. The

basic equations of the problem allow the greatest number of the real basic quantities to be enumerated. R. S. R.

**968. Systems of Units. W. M. Hall.** *Frank. Inst., J.* 225. *pp.* 197–218, *Feb.*, 1938.—Discusses the principles governing the formulation of self-consistent systems of units for the physical quantities used in all branches of physics and engineering. The principles are illustrated by the development of a system covering translational and rotational mechanics, electricity, magnetism, heat, light and sound, and comprehensive charts show in tabular form the development of the various systems in common use, and the dimensions of the quantities and the conversion factors relating their units in the various systems. L. H.

*See also* Abstracts 923, 946, 982, 1265, 1344.

## MECHANICS, QUANTUM.

**969. New Mechanics of Material Systems. M. Mathisson.** *Acta Physica Polonica*, 6. 3. *pp.* 163–200, 1937. *In German.*—Starting from the general Maxwell-Einstein electromagnetic equations in a gravitational field, a variational equation of motion is deduced. The equations of motion thus obtained contain new terms, and a new energy law appears, which has a new kind of energy, " the acceleration energy". [See following Abstract.] A. J. McC.

**970. Spinning Electron and its Dynamics. M. Mathisson.** *Acta Physica Polonica*, 6. 3. *pp.* 218–227, 1937. *In German.*—The new equations of motion deduced by the author [see preceding Abstract] are applied to the electron. It is found that a particle of mass $M$ and moment $\Omega$ possesses a *proper frequency* equal to $Mc^2/2\pi\Omega$. The phase of the spinning motion is not generally a one-valued function and the quantum laws merely express the one-valuedness of the phase, which necessitates the value $h/4\pi$ for the electron moment. A. J. McC.

**971. Use of Charge-Conjugated Wave Functions in the Hole Theory of the Electron. H. A. Kramers.** *K. Akad. Amsterdam, Proc.* 40. 10. *pp.* 814–823, 1937.—Between the charge conjugated wave functions $\psi_k$ ($k = 1, 2, 3, 4$) and $\psi^L$ which satisfy the wave equation in the cases where ' $e$ ' the electron charge is negative or positive respectively, a simple relation exists, when that particular representation is chosen for the matrices $\vec{\alpha}$, $\beta$ which causes the two components $\psi_1$, $\psi_2$ to transform like a relativistic spinor, and $\psi_3$, $\psi_4$ like a spin conjugated spinor, when a Lorentz transformation is applied. A representation where $\vec{\alpha}$, $\beta$i are real, has been used by Majorana on the quantum theory of the positive and negative electrons. Using this method some results of the Majorana calculus and also accordingly of the Dirac-Heisenberg formulation of the hole theory are given in this paper in a general form. G. O. B.

**972. Tensorial Equations of the Magnetic Electron. J. Yvon.** *Comptes Rendus*, 205. *pp.* 1367–1369, *Dec.* 27, 1937.—In Dirac's theory of the electron in a prescribed electromagnetic field, the electron is defined at all points in the field by 16 tensorial parameters, which do not appear in the differential equations defining the evolution of the electron. There are nine algebraic relations between the 16 tensorial parameters; the unknowns of the differential equations are four imaginary wave functions. By eliminating the wave functions a system of non-linear differential

equations is obtained which apparently are more difficult to solve than the original equations. The author derives expressions for the nine algebraic relations between the 16 tensorial parameters for the case in which the field is appreciably modified by the presence of the electron. Five of these relations, in a slightly different form, are already known. J. S. G. T.

**973. Centre of Gravity and Indeterminacy Relationships. J. L. Destouches.** *Comptes Rendus*, 206. *pp.* 319–321, *Jan.* 31, 1938.—The author replies to Solomon [see Abstract 467 (1938)]. J. S. G. T.

**974. Eddington's Interpretation of Dirac's Equation. G. Lemaître.** *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 165–172, *Dec.* 31, 1937.—Eddington in his interpretation of the Dirac electron equation employs Clifford's complex numbers of the fourth order and represents these numbers by matrices with the essential restriction that the numbers should be entirely real or entirely imaginary. This paper develops the theory of fourth order Clifford numbers, or quadriquaternions, treating them as products of two systems of quaternions. Eddington's condition is observed by restricting the hypercomplex numbers to those whose components are real numbers; his fundamental equation which forms the basis of his interpretation of the Dirac equation is deduced, and it is shown that the theory can be developed symbolically, independent of a particular representation. N. M. B.

**975. Beginnings of the New Quantum Theory. H. T. Flint.** *Phys. Soc., Reports*, 4. *pp.* 134–172, 1938.—Progress review.

**976. Rotational Energy-Levels of a Diatomic Molecule in a Tetrahedral Field. H. M. Cundy.** *Roy. Soc., Proc.* 164*A*. *pp.* 420–435, *Feb.* 4, 1938.—It is shown by general principles of the theory of groups how the Schrödinger equation may be solved for a diatomic molecule, when the potential energy varies with the angular coordinates in such a manner that it has the symmetry of the regular tetrahedron. Infinite series for the wave-functions are given, and the energy-levels and corresponding wave-functions evaluated for a particularly simple potential-energy function of the given type. Three methods of obtaining these levels are described, two of which are asymptotic approximations, and the third involves the use of the Mallock electric calculating machine. A good agreement is obtained between the three, enabling a plot to be made of the energy-levels over wide ranges of magnitude of the potential energy term. AUTHOR.

**977. Applications of Super-Quantisation in the Wave-Mechanics of the Electron. E. Durandin and A. Erschow.** *Phys. Zeits. d. Sowjetunion*, 12. 4. *pp.* 466–471, 1937. *In German.*—It is shown that the particles of Proca's theory, which are described by a differential equation of the second order, obey Bose statistics and have zero average spin and magnetic moment. These properties are contrary to the observed properties of electrons. It is concluded that it is impossible to construct a second order equation for particles obeying anti-symmetric statistics. G. C. McV.

**978. Central Limit Theorem of Statistical Mechanics. K. Husimi.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 1105–1112, *Dec.*, 1937. *In English.*—Darwin and Fowler's method, based on Cauchy's theorem, of establishing the central limit theorem of statistical mechanics applies only to dynamical systems in which the eigenvalues of the energy are expressable by integral values of a suitable unit. In general, when the energy values are irrational the partition function is no longer a power series, and Fowler proposed to meet the problem by approximating the irrationals by rationals with a common denominator. This paper over-

comes the difficulty of uniformly approximating an infinite number of irrationals by developing a general method to cover the cases of rational and irrational eigenvalues uniformly. N. M. B.

**979. Statistical Mechanics of Condensing Systems. Parts III and IV. J. E. Mayer and S. F. Harrison.** *J. Chem. Phys.* 6. *pp.* 87–104, *Feb.*, 1938.—A general development of the Gibbs phase integral for a system of chemically saturated molecules gives equations for the thermodynamic properties of the system. The equations predict the usual condensation phenomenon of the gas to form a condensed phase with a surface tension at temperatures below a characteristic temperature $T_m$. At $T_m$ the surface tension of the condensed phase is zero, and this phase undergoes a discontinuous change without heat of transition. Between $T_m$ and the true critical temperature $T_c$, there exists a finite volume interval for which P and the Gibbs free energy F is independent of the volume. Above $T_c$ the usual P — V diagram predicted above the critical point is found, with no volume for which $(\delta P/\delta V)_T$ is zero. In Part IV it is shown that the above theoretical equations lead to the prediction that, in a finite density and temperature range above the temperature of disappearance of the meniscus, microscopic densities are equally stable, and in a sealed bomb different densities may be observed at a given temperature and average density. The densities observed in various parts of the bomb will depend in a predictable way on its previous history. This is in agreement with the published results of O. Maass on systems in the neighbourhood of the critical point. [For Part II see Abstract 521 (1937).] AUTHORS.

**980. Computation of Fermi-Dirac Functions. J. McDougall and E. C. Stoner.** *Roy. Soc., Phil. Trans.* 237*A*. *pp.* 67–104, *Feb.* 7, 1938.—The application of Fermi-Dirac statistics to physical problems (examples of which are indicated) requires the evaluation of integrals of the form $F_k(\eta) = \int_0^\infty \{x^k/(e^{x-\eta} + 1)\}dx$, especially for $k = \frac{1}{2}$ and $k = \frac{3}{2}$, and of a number of related functions. This paper is primarily concerned with the evaluation of $F_{\frac{1}{2}}(\eta) = F$, from which the other functions may be obtained, for a wide range of values of the argument $\eta$. Series expansions, which are available for $\eta \gg 1$ and $\eta < 0$, corresponding to $\epsilon_0/kT \gg 1$ and approximately $\epsilon_0/kT < 1$ ($\epsilon_0$ being the maximum particle energy in the Fermi-Dirac distribution at absolute zero), are studied in detail and are employed in the calculation of F for $\eta \geqslant 16{\cdot}0$ and $\eta < 0{\cdot}0$. The determination of F(0) is carried out by means of a relation between the functions $F_k(0)$ and the Riemann zeta functions. For values of $\eta$ between 0 and 16, the computations are made by numerical integration methods, supplemented by the use of series for the initial and final parts of the $x$ range. A direct method is used for $0{\cdot}0 \leqslant \eta \leqslant 3{\cdot}0$, but for $3{\cdot}0 \leqslant \eta \leqslant 16{\cdot}0$, a modified procedure greatly reduces the work of computation. From the $F_{\frac{1}{2}}(\eta)$ table so obtained, values of $F_{\frac{3}{2}}(\eta)$ are found by numerical integration, and of the derivatives F′, F″ and F‴ by numerical differentiation. The final table gives, at tabular intervals $w = 0{\cdot}1$, the values of the functions $\frac{2}{3}F_{\frac{3}{2}}(\eta)$, $F_{\frac{1}{2}}(\eta) = F$, $wF'$, $w^2F''$ and $w^3F'''$, to six decimal places for $-4{\cdot}0 \leqslant \eta \leqslant +4{\cdot}0$, and to five decimal places for $4{\cdot}0 \leqslant \eta \leqslant 20{\cdot}0$. Convenient methods for direct and inverse interpolation are described. Some properties of the $F_k(\eta)$ functions, defined only for $(k + 1)$ positive, are discussed, and an analytic continuation of the functions, obtained in an Appendix, enables these properties to be established for a wider range of $k$ values. AUTHORS.

*See also* Abstracts 988, 989, 1112, 1306.

## PRESSURE.

*See* Abstract 1230 and

772B. Vacuum Measurement by Ionic Current. G. Herrmann and I. Runge.

773B. Direct Reading High Sensitivity Membrane Vacuum Gauge. C. Brinkmann.

774B Low Pressure Measurement with Ionisation Gauge. R. H. Healy and J. W. Reed.

## RELATIVITY AND ETHER.

**981. Theory of Relativity. C. W. Oseen.** *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A. No.* 30. [10 *pp.*] *and* 25*A. No.* 31. [12 *pp.*], 1937. *In French.*—The equation of wave-propogation is solved in a general manner assuming spherical symmetry in space. The solutions lead to a representation of the Lorentz group. In the second paper a general discussion is given of the solutions with axial symmetry of Einstein's gravitational equations. G. C. McV.

**982. Different Forms of an Action Function Expressed by Means of Complex Variables. M. A. Tonnelat-Baudot.** *Comptes Rendus,* 206. *pp.* 44–46, *Jan.* 4, 1938.—An action function dependent upon six invariants defined in terms of complex variables, such as have been used by Rao [see Abstract 526 (1937)], is discussed. The invariants are expressed in terms of those used by Born, and by proceeding along lines similar to those used by Infeld in the case of three invariants, relations are established between the invariants, and various forms of the active function are derived. J. S. G. T.

*See also* Abstracts 969, 970.

## SOLUTION.

**983. Gaseous Solubility and Surface Tension. H. H. Uhlig.** *J. Phys. Chem.* 41. *pp.* 1215–1225, *Dec.*, 1937.—By making use of the Maxwell-Boltzmann distribution theorem in a consideration of the energy change in transferring a solute molecule of radius $r$ to a solvent of surface tension $\sigma$, the expression $\log_n\gamma = (-4\pi r^2\sigma + E)/kT$ is found. E is the " interaction energy " of solute and solvent, and $\gamma$ is the Ostwald solubility coefficient. For several gases, *e.g.*, $O_2$, H, N, CO and $CH_4$, E is approximately constant for any one gas in a variety of solvents. The radii $r$ found from a plot of log $\gamma$ with $\sigma$ of the solvents (for any gas) are in good agreement with radii calculated from physical measurements of other types. E, the intercept, is negative if the solubility of the gas is small, and positive if large. The free energies of solution of gas calculated from E so determined compare well with values obtained from the temperature dependence of gas solubility for most solvents, the notable exception being water. Least square treatment of Horiuti's data for $N_2$ and CO over a 40° C. range show that the solute molecular radii determined from the surface tension plots tend to be constant. E decreases with increasing temperature. Because E is the difference in the solute-solvent interaction of gas and liquid phases, it must be zero at $T_c$. It is shown that E is a minimum at a temperature below the critical temperature of the solvent. P. H. B.

**984. Solubilities and Activity Coefficients of Lanthanum Iodate in Concentrated Salt Solutions at 25° C. J. N. Pearce and W. C. Oelke.** *J. Phys. Chem.* 42. *pp.* 95–106, *Jan.*, 1938.—The solubility behaviour of lanthanum iodate at 25° C. has been investigated in solutions of KCl, $K_2SO_4$, $MgCl_2$, and $MgSO_4$ from 0·001 *M* up to concentrations

approaching saturation. The solubility of lanthanum iodate is increased by the presence of added salts. The effect of the different salt types is in the order KCl $<MgCl_2 < < < MgSO_4 < K_2SO_4$, which agrees with the work of earlier investigators. A modern theory of solubility is postulated to explain the effects observed. AUTHORS.

**985. Solubility and Activity Coefficient of $AgIO_3$ in $KNO_3$ Solutions. Standard Potential of Ag-$AgIO_3$ Electrode. I. M. Kolthoff and J. J. Lingane.** *J. Phys. Chem.* 42. *pp.* 133–140, *Jan.*, 1938.—The solubility and activity coefficient of $AgIO_3$ in $KNO_3$ solutions have been investigated up to an ionic strength of 1 *M*. The concentrations of both silver and iodate ions in the saturated solutions were determined. The activity product of $AgIO_3$ at 25° C. was found to be $3{\cdot}04 \times 10^{-8}$. It was shown that saturated solutions of $AgIO_3$ in pure water contain a greater concentration of iodate than of silver ions, when uncoated glass vessels are used. This is attributed to an exchange between kations in the glass surface and silver ions in the solutions. The error resulting from this exchange was eliminated by coating the glass vessels with paraffin. It was found that barium and thallous ions exchange with silver ions on the surface of $AgIO_3$. The standard potential of the Ag-$AgIO_3$ electrode $IO_3^-$ (a = 1), $AgIO_3$(S)/Ag, was computed from the activity product of $AgIO_3$ and found to be $0{\cdot}3551 \pm 0{\cdot}0002$ V at 25° C. AUTHORS.

*See also* Abstract 1221.

## SURFACE PROPERTIES.

**986. Gases in Metals. Part IV. J. A. Kljatschko.** *Acta Physicochimica*, 6. 5. *pp.* 737–744, 1937. *In German.*—A type of chain reaction is proposed to account for the selective adsorption of water vapour on the inner surface of Al and some of its alloys on excessive heating. The possibility of preventing blister formation in superheated Al by a thermal treatment in a $Cl_2$ (or other vigorous oxidising agent) atmosphere is shown experimentally. The effect of the rate of heating on blister formation in Al is examined both theoretically and practically and it is concluded that a rapid rate is conducive to the formation of more blisters. [See also Abstract 5353 (1936).] H. J. H. S.

**987. Adsorption of Gases by Solids. E. K. Rideal.** *Phys. Soc., Reports*, 4. *pp.* 27–39, 1938.—Progress review.

**988. Statistical Mechanics of the Adsorption of Gases at Solid Surfaces. F. J. Wilkins.** *Roy. Soc., Proc.* 164*A*. *pp.* 496–509, *Feb.* 18, 1938.—The generalised adsorption isotherm is shown to be

$$\frac{C_g}{C_a} = \frac{f_g(T)B_{Ng}(T)}{f_a(T)B_{Na}(T)} \exp\left[-\frac{\phi}{RT} + N_g \frac{\partial}{\partial N_g} \log B_{Ng}(T) - N_a \frac{\partial}{\partial N_a} \log B_{Na}(T)\right],$$

where $C_a$ and $C_g$ are the molecular concentrations in the adsorbed and gaseous phases respectively; $\phi$ is the adsorption potential and $f_g(T)$, $f_a(T)$, $B_{Ng}(T)$ and $B_{Na}(T)$ are partition functions. These functions have been evaluated for three special cases in which the adsorbed phase is (*a*) a three-dimensional gas, (*b*) a gas of two-dimensional lateral mobility whose molecules vibrate in a plane perpendicular to the plane of lateral mobility, and (*c*) a group of Planck oscillators with three degrees of freedom. The relation between $\phi$ and $q$, the differential heat of adsorp-

tion, is deduced and it is shown that the common practice of calculating from the equation $(\partial \log p/\partial T)_x = -q_x/RT^2$ is erroneous. The correct equation is $(\partial \log p/\partial T)_{(x/ad)} = -q/RT^2$, where $(x/ad)$ is the concentration in the adsorbed layer. AUTHOR.

**989. Adsorption of A, $N_2$ and $O_2$ on Smooth Pt Foil at Low Temperatures and Pressures. F. J. Wilkins.** *Roy. Soc., Proc.* 164*A*. *pp.* 510–531, *Feb.* 18, 1938.—The adsorption of A, $N_2$ and $O_2$ on a smooth Pt foil has been measured at various temperatures between 77 and 193° K. over the pressure range of $5 \times 10^{-3}$ to $2 \times 10^{-1}$ mm. It is found that the deviations from the Langmuir adsorption isotherm are greater the lower is the temperature. The value $\alpha$ of the fraction of the apparent surface covered by the gas at saturation is unity only for A at 77° K. In all other experiments $\alpha$ was much less than unity. Further, the rate of decrease of $\alpha$ with increase of temperature is much more rapid than is given by Zeise's linear equation and can be expressed approximately by $\alpha = ce^{-\beta/T}$, where $c$ and $\alpha$ are constants. After a discussion of the results, using the virial adsorption isotherm, the failure of the Langmuir adsorption isotherm at low temperatures is attributed to the intermolecular forces of attraction which exert a pronounced effect on the amount of gas adsorbed. The adsorption potentials of A and $N_2$ are calculated to be approximately 5000 and 5500 cal./gm. mol. respectively. These compare with the corresponding values calculated from quantum mechanics of 3200 and 1500 cal./gm. mol. The possible reasons for the discrepancy are discussed. AUTHOR.

**990. Simple Formulæ for the Adsorption of Mixtures. A. Boutaric.** *Comptes Rendus*, 205. *pp.* 1149–1151, *Dec.* 6, 1937.—The formulæ given apply to adsorption equilibrium of two molecular or ionic species (*e.g.*, of solvent and solute) upon a solid adsorbent and are based upon Perrin's treatment. L. V. C.

**991. Adsorption of Acetic Acid by Animal Charcoal. M. Dobine.** *Comptes Rendus*, 205. *pp.* 1388–1391, *Dec.* 27, 1937.—The adsorption of acetic acid on animal C has been studied for both concentrated and dilute solutions of the acid, and for moist and dried C. Results show that the varying reports of previous workers can be ascribed to the fact that the C they used was of different dryness. The adsorption isotherm reaches a maximum for C not specially dried, whereas it is S-shaped for dried C. The initial parts of both curves are the same. The adsorptive power of C is not affected by drying. A. J. M.

**992. Surface Tensions of Alcohol-Water Mixtures. S. Valentiner and H. W. Hohls.** *Zeits. f. Physik*, 108. 1–2. *pp.* 101–106, 1937.—With a view to determining the temperature coefficients of the surface tensions of both ethyl and methyl alcohol solutions, the surface tensions were measured by the ring method from 0% to 100% by volume over the interval 20° C. to 50° C. The temperature coefficients found are the subject of brief comment. The results are in good agreement with existing values. P. H. B.

**993. Surface Tension. R. C. Brown.** *Phys. Soc., Reports*, 4. *pp.* 40–52, 1938.—Progress review.

**994. Theoretical Calculation of Parachors. R. H. Fowler.** *Physica*, 5. *pp.* 39–45, *Jan.*, 1938. *In English.*—By using the experimental fact that P in Sugden's parachor equation is a good constant over a wide temperature range, one can evaluate P in terms of known constants by

referring to low temperatures, *e.g.*, near the melting point, where the density of the vapour phase is negligible and the surface energy can be taken as independent of temperature. The lines of the calculation are given, together with the final expression for $P^4$, which is three or four times as large as the expression derived by the author from consideration of the neighbourhood of the critical temperature [see Abstract 1550 (1937)]. The results of the two formulæ are compared with experimental values of P for twelve liquids, and are briefly discussed. P. H. B.

**995. Monomolecular Films on Mercury. H. Devaux.** *Comptes Rendus*, 205. *pp.* 1343–1346, *Dec.* 27, 1937.—When talc is very lightly dusted on a clean Hg surface and a small trace of a fatty substance is placed at the centre, it briskly spreads to a talc-free circle several cm. in dia. A current of water-saturated air then blown over the surface, as from the mouth, instantly produces a strikingly white appearance in the circle which is sharply separated from the surrounding surface. This is due to the formation of discrete water globules on the film-covered area which is not easily wetted, while on the outer Hg the globules tend to spread and coalesce. The phenomenon is used to demonstrate the strong attractive power of a Hg surface for most fatty substances. Hydrophilic substances are similarly attracted, but show the phenomenon only temporarily, if at all. P. H. B.

**996. Homogeneous Transformations in Monomolecular Films. D. G. Dervichian and M. Joly.** *Comptes Rendus*, 206. *pp.* 326–328, *Jan.* 31, 1938.—Besides the discontinuous changes, such as condensation, solidification, etc., that occur in monomolecular films as a result of changes in temperature or superficial pressure, rapid, though not absolutely discontinuous, changes occur in compressibility (K), viscosity (V) and electric moment ($\mu$), all at approximately the same points. This is illustrated by triolein in which a sharp change in K occurs at 110–115 $Å^2$/mol., in V and $\mu$ at 115, with which may be compared the homogeneous change that occurs in oleic acid at 36 (= approximately 115/3 $Å^2$/mol.). Similar changes occur in stearic acid and in tricaproin, as also in $dp/dc$ ($p$ = surface tension, $c$ concentration) in films of fatty acids (with 8–11 C.) on $H_2O$ at 40–50 $Å^2$/mol., this being the area above which the molecules are in the "gaseous state" and lying flat on the surface. [See Abstract 2978 (1937).] C. A. S.

*See also* Abstracts 943, 983, 1151, 1288, 1303, 1364 and

689B. Corrosion of Iron at the Boundary Metal-Liquid-Gas and Metal-Liquid-Liquid. M. K. Tikhonov.

## TIME.

***997. Clocks Showing Mean Solar and Sidereal Time Simultaneously. E. Esclangon.** *Comptes Rendus*, 206. *pp.* 289–292, *Jan.* 31, 1938.—This paper suggests a number of suitable gear trains whereby a single pendulum, beating either mean solar or sidereal seconds, may be used to give simultaneous readings on two dials of both mean and sidereal time. The list of suggested trains includes two, $\frac{11.23.31.311}{19.289.443}$ and $\frac{5.23.41.373}{59.81.367}$, which give the difference between mean sidereal and mean solar time in the year 2038 correct to within 0·02 sec. J. S. C.

***998. Measurement of Time. H. Spencer Jones.** *Phys. Soc., Reports*, 4. *pp.* 1–26, 1938.—Progress review.

### VISCOSITY AND FRICTION.

**999. Viscosity and Chemical Constitution. M. Souders, Jr.** *Am. Chem. Soc., J.* 60. *pp.* 154–158, *Jan.*, 1938.—An equation relating viscosity and density, $\log_{10}(\log_{10}\eta) = md - 2{\cdot}9$, is found to fit the data on 117 organic liquids. The viscosity-density constant, $m$, is characteristic of each liquid and when multiplied by molecular weight becomes a constitutive property, I, of each compound. Values of atomic and structural constants are derived from which the viscosity-constitutional constant, I, may be calculated. Comparison of the observed and calculated values of I for 117 organic liquids indicates, in nearly all cases, errors of less than 1%. AUTHOR.

**1000. Initial Flow of a Viscous Fluid. H. Poncin.** *Comptes Rendus*, 206. *pp.* 94–96, *Jan.* 10, 1938.—Formulæ are derived relating to the transitory *régime* in the laminar flow of a viscous fluid, and to the effect of variation of the amount of fluid used upon the values of coefficients of viscosity as determined in capillary viscosimeters. J. S. G. T.

***1001. Vibration Viscometry. R. Auerbach.** *Kolloid Zeits.* 82. *pp.* 24–25, *Jan.*, 1938.—Pastes of finely divided materials such as cement with liquids such as water begin to flow when l.f. mechanical vibrations are impressed upon them. A so-called " vibration-viscometer " is described for measuring viscosities in such cases. Using a frequency of 100 per sec., it is found that the viscosities of pastes of cement and $SiO_2$ diminish rapidly as the amplitude of the vibrations is increased. The time taken for dry sand to flow in an hour-glass increases when vibrations are impressed. L. A. W.

***1002. Capillary-Type Viscometer. P. E. Raaschou.** *Indust. and Engin. Chem.* (*Analytical Edition*), 10. *pp.* 35–39, *Jan.* 15, 1938.—An instrument is described which can be used in two different ways for determining viscosities from 1·5–100, and from about 100–5000 centipoises. Errors due to surface tension are reduced to a minimum, the zero adjustment can be made with great accuracy, the efflux quantity is constant, and viscosity determinations can be made over a wide range of temperature. The instrument can also be used for determining surface tension by the method of capillary rise. A. J. M.

*See also* Abstracts 917, 1296.

## ASTRONOMY AND ASTROPHYSICS.

### ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1003. New Double-Image Astronomical Micrometer. P. Muller.** *Comptes Rendus*, 205. *pp.* 961–963, *Nov.* 22, 1937.—The filar micrometer is a very imperfect instrument for measurement of double stars and small diameters, and the principle of the double image has long been recognised as superior ; but no instrument had been designed on this principle that was free from serious defects. A satisfactory form is now in use at Strasburg Observatory. A Rochon or Wollaston prism is fixed in the telescope so as to be in its focus, with the outer face normal to the axis, and is oriented so as to double the image in a direction parallel with the axis of the micrometer screw. The relative distance of the two images of a star varies as the displacement of the prism, and the images coincide when the

screw is not far from the middle of its course. The prism is the only additional optical part in the telescope, and its movements can be very accurately controlled with a very small movement of the screw. Measures are made with great rapidity, and with less fatigue and more confidence than with a filar micrometer. Up to November 8, 1937, 337 observations had been made of 127 double stars, and a statistical summary of results is given. The few difficulties inherent in the method are far outweighed by its advantages. The instrument has further been adapted for measuring the brightness of close components, and can be used without any modification either as photometer or micrometer. M. A. E.

***1004. Central Grating for Trigonometrical Parallax of Bright Stars. E. Johansson.** *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*B*. *No.* 22. [6 *pp.*], 1937. *In English.*—The author considers the reduction of the magnitude of a parallax star to a mean magnitude of comparison stars by the methods of a rotating sector with adjustable aperture placed just in front of the plate, and by means of a parallel wire grating placed in front of the objective. He suggests a third method of placing a small centre grating in front of the objective and discusses three objections to it, and two advantages attending it. It is found that this method does not increase the accidental errors, but whether it would introduce new systematic errors can only be answered by observing stars with known parallax. A programme for this purpose has been started at the Upsala Observatory. A. S. D. M.

***1005. Performance of Rotatory Spectrograph. Y. Öhman.** *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*B*. *No.* 23. [8 *pp.*], 1937. *In English.*—The instrument previously described [see Abstract 2995 (1937)] has been modified so that the third Iceland spar plate can be turned in position angle, and the 4 stellar images placed in a straight line. For colorimetric work it is placed immediately in front of the photographic plate, giving u.v. colour indices of stars of photographic magnitude 16 in 1 hr. at the Newtonian focus of a 40-in. mirror. For radial velocity work it is placed in front of a slitless spectrograph, giving spectra of 12th mag. stars in 2·5 hr. U.v. colour indices are measured for 33 stars in Messier 38, with a mean error of $\pm$ 0·04 mag., and the run of the results with spectral type and with the ordinary colour index is discussed. Radial velocity determinations of sufficient accuracy will be possible from slitless spectrograms of faint extra-galactic nebulæ, since the "half-intensity" point of reference can be determined to about 11Å, or 800 km./sec. Study of the colours of faint stars in the Selected Areas is also facilitated. Photographs illustrating the performance of the instrument are reproduced. A. Hu.

***1006. Design and Operation of Harvard-M.I.T. 1936 Eclipse Equipment. D. H. Menzel, J. C. Boyce, H. Hemmendinger, R. d'E. Atkinson and W. R. Brode.** *Harvard Coll. Obs., Ann.* 105. *pp.* 87–98, 1937.

***1007. Harvard Photoelectric Microdensitometer. G. Z. Dimitroff and D. H. Menzel.** *Harvard Coll. Obs., Ann.* 105. *pp.* 99–106, 1937.

***1008. Double Monochromator at Babelsberg for Testing Astrophotometric Instruments. M. Güssow.** *Zeits. f. Astrophysik,* 14. 5. *pp.* 297–311, 1937.—By means of Planck's law of radiation the colour-temperature of a star can be deduced from the measured intensity in two different regions of its spectrum, provided that the colour sensitive-

ness of the photometric instrument used is accurately known. The author has designed an apparatus including a double monochromator, with which the colour sensitiveness of photo-cells, filters, and object-glasses are determined. The installation is shown in two illustrations: it can be used with ease and rapidity by one observer. Three photo-cells, a yellow and a blue filter, a neutral platinum and a step-platinum filter have been examined; and the high degree of accuracy obtained in the measurements is apparent from the tables and diagrams which show the results. M. A. E.

*See also* Abstracts 998, 1034, 1043.

## COMETS AND METEORS.

**1009. Spectroscopic and Photometric Observations of Comet Finsler (1937 f). A. Colacevich.** *Accad. Lincei, Atti*, 26. *pp.* 227–232, *Oct.*, 1937.—At Arcetri Observatory on July 27, 28, 29, 1937, five spectrograms were obtained of this comet, and measures were made of the positions and intensities of the bright monochromatic emission bands and of the continuous spectrum, using as comparison stars 9, 5, and 10 Camelopardalis. Methods and instruments used are described in detail. The spectrum is characteristic of comets when not very near the sun. The origin of the Raffety band and of the band at 4315 Å is uncertain; those in the red at 6000–6600 Å, which overlap one another, are probably due to CN, but perhaps also partly to the Swan bands. The great intensity of the band of CN at 3880 Å is remarkable; and of the four Swan bands identified the most intense is in the green and the next in the blue at 4370. It is to these two, not to the CN, that the greenish-blue colour of the comet is due, resembling that of a B-type star. M. A. E.

**1010. Visible Spectrum of Comet Finsler. J. Gauzit.** *Comptes Rendus*, 206. *pp.* 169–170, *Jan.* 17, 1938.—Three spectra on AGFA ISS panchromatic plates were obtained on 1937, Aug. 3, 4 and 6, showing the nucleus and head but no tail. Swan bands are evident on a feeble continuous background, but numerous other lines and bands are seen in the visible region, perhaps due to emission: $CO^+$ bands characteristic of tails are seen in the head; also the "red spectrum" of CN and the first positive system of $N_2$. Confirmation is given of tail bands between 3800–5000 Å [see Abstract 1974 (1937)] seen in the head of Comet Peltier, and the author discusses R. Minkowski's objections to the presence of red CN spectrum, since the latter bases this on his identification with the Asundi system for CO (transition $a'^3\Sigma \rightarrow a^3\Pi$) of the wave-length 5443–6646 Å. A. S. D. M.

**1011. Spectrum of a Bright Meteor. C. Schalén and G. Wernberg.** *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*A*. *No.* 26. [10 *pp.*], 1937. *In English.*—The spectrum of a bright meteor, observed at Upsala on 1936, Oct. 19, is described. The spectrum belongs to the type having strong H and K lines of ionised Ca. The spectrum as a whole appears to consist of lines only, most of which belong to Fe multiplets. The intensities of the lines are also given in a number of cases. G. C. McV.

**1012. Arizona Expedition for Study of Meteors. Part VI. E. Öpik.** *Harvard Coll. Obs., Ann.* 105. *pp.* 549–600, 1937.—[For Parts II–V see Abstract 4906 (1934).]

**1013. Meteor Photographs Taken through a Rotating Shutter. P. M. Millman and D. Hoffleit.** *Harvard Coll. Obs., Ann.* 105. *pp.* 601–621, 1937.

**1014. Distribution of Meteoric Masses in Interstellar Space. F. Watson, Jr.** *Harvard Coll. Obs., Ann.* 105. *pp.* 623–632, 1937.

**1015. Real Paths of Fireballs. R. A. McIntosh.** *Roy. Astron. Soc. Canada, J.* 32. *pp.* 1–24, *Jan.*, 1938.—A large number of observations made by the general public, when sifted and interpreted by an experienced meteor observer, may be made to yield almost as accurate results regarding the path of a bright fireball as simultaneous records by two or three trained observers. The best methods of collecting the data when exceptional fireballs have been seen, of eliminating errors, and selecting the points of most value, finally the trigonometrical method of deducing the true path, are all described from the writer's own experience in dealing with this kind of material. Descriptions of luminous trains should be specially noted, as they give valuable information regarding currents in the upper atmosphere and the varying level of the ionosphere. Trains above 50 miles elevation are said to move chiefly to the east, and below that west, often with great velocities. Notes on detonations and rumblings are also very useful, since they cannot be heard until the meteor has fallen below the ozone layer (about 34 miles) ; and they are audible at places up to 50 miles away, beyond which is a zone of silence, another zone of audibility occurring at about 90 miles away. Over 30 works on the subject are listed for reference. M. A. E.

*See also* Abstracts 1135.

## COSMOGONY.

**1016. Fundamental Problems of Cosmogony and Newton's Law. G. Armellini.** *Accad. Lincei, Atti*, 26. *pp.* 209–215, *Oct.*, 1937.—No cosmogonal hypothesis regarding the planetary system is without numerous difficulties, and such difficulties become still more grave when it is sought to explain why amongst the extra-golactic nebulæ there are so many nebular nuclei having the form of extremely flattened ellipsoids. Theoretically their polar axis should not be less than 2/5 of the equatorial whilst observation shows that this ratio is often of the order 1 : 10. The author considers that gravity, inertia and matter are three aspects of a single mystery and that gravity can only be really explained when it is known what matter exactly is. It is suggested that a great number of cosmogonal problems become immediately explicable if a modification is made in Newton's law and it is admitted that the coefficient of attraction $f$ varies slightly with the velocity of recession or approach of the two attracting points. The hypothesis suggested is that the force of attraction F between two masses $m$ and $m^1$ should be represented by the formula $F = -f(1 + \epsilon\, dr/dt)mm^1/r^2$, where $f$ is the gravitational constant and $\epsilon$ is a second constant supposed extremely small and positive, the smallness being such that it produces no sensible effect on the motion of the planets in an interval such as a century, but the case is very different when millions of centuries are considered. J. J. S.

**1017. Evolution of a Cosmical Dust-Cloud. K. Hillebrand.** *Akad. Wiss. Wien, Ber.* 146. *2a.* 5–6. *pp.* 291–369, 1937.—The motions of a cloud of mass-particles which initially formed a spherical aggregate of uniform average density are studied in great detail. Newtonian mechanics in Euclidean space are assumed. The aggregate is shown to be unstable. The effect of a collision between two particles is that their orbits after the collision tend to be closer to the centre of the aggregate than

they were before. Further developments show that the aggregate would eventually tend to a form not unlike that of the solar system. G. C. McV.

**1018. Static Universe and Nebular Red Shift. Part II. S. Sambursky and M. Schiffer.** *Phys. Rev.* 53. *pp.* 256–263, *Feb.* 1, 1938. —The geometric foundation and the mathematical consequences of the model of a static universe proposed in a previous paper [see Abstract 3940 (1937)] are discussed. The formula for the gravitational constant is proved and some cósmological applications are pointed out. AUTHORS.

*See also* Abstract 1028.

## DYNAMICAL PROBLEMS (ASTRONOMICAL).

**1019. Calculation of the Term in the Motion of the Lunar Perigee with Characteristic $e'^4$. E. W. Brown.** *Roy. Astron. Soc., M.N.* 98. *pp.* 170–171, *Dec.*, 1937.—The predicted contribution of about 11″ in the centennial motion of the lunar perigee, due to the coefficient of $e'^4$, [see Abstract 1088 (1937)] was originally arrived at by estimating the sum of a series. The author now announces that a numerical evaluation of the series yields $11'' \pm 0''{\cdot}2$. G. C. McV.

*See also* Abstracts 1027, 1067.

## LATITUDE AND LONGITUDE.

**1020. Horizontal Pendulum Movements in Relation to Latitude Variation. F. N. Denison.** *Roy. Astron. Soc. Canada, J.* 32. *pp.* 25–29, *Jan.*, 1938.—A daily record of some curious " wanderings " of the E-W and N-S seismographic pendulums has been kept, with the omission of a few years, from 1899 to the present time, first at Victoria, B.C., and later at Gonzales Heights Observatory ; and several papers have been published on the results. Curves of these movements indicate that, though influenced by temperature changes, these are not their primary cause, but that there exists a marked correlation with latitude variations as observed at Ukiah, California, the eastward movement agreeing with increase of latitude. The N-S pendulum records show a marked secular movement to south, which may indicate a rising of the British Columbia coast compared with that of California, as already suggested by Pacific Coast tidal records. Highest and lowest points in the curves, especially of the N-S pendulum, also tend to occur at times of new and full moon and at maximum lunar declination, as well as when there are destructive earthquakes. That these pendulum movements are more pronounced at Victoria than in other parts of America may possibly be partly explained by the unusually high positive gravity anomaly recently found here, of 0·054. M. A. E.

## NEBULÆ.

**1021. Red Nebulosity and Star Distribution in Orion. K. Graff.** *Akad. Wiss. Wien, Ber.* 146. 2*a*. 3–4. *pp.* 203–204, 1937.— East and north-east of Orion's belt a region of red nebulosity is easily seen with a binocular in the clear air of Majorca, though apparently only one observer (R. de Terwangne) has seen it in more northerly latitudes. Counts of B stars in this part of the sky also suggest the presence of absorbing matter, and photographic evidence has been found in one of the Wolf-Palisa maps, which is here reproduced. A line has been drawn across it,

above the belt stars of Orion, to mark the boundary between red nebulosity and clear blue-black sky as seen in Majorca, and this line also divides a very poor from a very rich star region. M. A. E.

**1022. Dark Nebula at ρ Ophiuchi. Å. Wallenquist.** *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*B*. *No.* 28. [7 *pp.*], 1937. *In English.* —R. Müller has found from star-counts that the nebula consists of two dark clouds one behind the other [see Abstract 1920 (1932)]; the more extensive cloud at 250 parsecs has a total absorption of $2 \cdot 5^{m}$; the dark central region about 100 parsecs nearer, the total absorption of both being 4 magnitudes. The author bases his work on a spectral classification of about 1000 stars (brighter than $mph \leq 11 \cdot 0$) of classes B-F8 within an area of 71 square degrees [see Abstract 1049 (1938)] and considers only the more distant nebula which he divides into two parts; the dark region of 27 square degrees, and the bright of 29. The results are shown in table and figure; the nebula sets in at 250 parsecs (in accordance with Müller); its radial extension is 750 parsecs; its absorption per 100 parsecs is 0·27 mag., and total absorption is 2·0 mag. A. S. D. M.

**1023. 36000 Galaxies in the South Polar Cap. H. Shapley.** *Harvard Coll. Obs., Ann.* 105. *pp.* 137–208, 1937.

**1024. Red Indices of 104 External Galaxies. C. K. Seyfert.** *Harvard Coll. Obs., Ann.* 105. *pp.* 209–217, 1937.

**1025. Faint Northern Galaxies. C. K. Seyfert.** *Harvard Coll. Obs., Ann.* 105. *pp.* 219–236, 1937.

**1026. Stellar Distribution in the Vicinity of a Southern Galactic Window. B. J. Bok and E. M. Lindsay.** *Nat. Acad. Sci., Proc.* 24. *pp.* 4–9, *Jan.*, 1938.—Star counts from a Bruce plate for $mpg = 14 \cdot 0$ to 18·2 made at Harvard are compared with Lindsay's (unpublished) counts for $mpg = 10 \cdot 0$ to 13·5 for the southern galactic belt, and indicate good accord; and as Lindsay's counts show that up to 13·5 there is no excess of stars for the region of the galactic window, the authors conclude that the number of stars brighter than $mpg = 13 \cdot 5$ for this region do not differ significantly from neighbouring fields at the same galactic latitude. It would seem that the total photographic absorption for regions $\beta = -10°$ to $-15°$ and $\lambda = 280°$ to 320° does not exceed $\Delta m \leq 1^{m} \cdot 00$; implying that (at $\beta = -11° \cdot 5$) the half-value of the "optical thickness" of the galactic absorbing layer is of the order, $0 \cdot {}^{m}20$ for this particular part of the sky. A. S. D. M.

**1027. Possibility of Expansion of a Slowly Rotating Spheroidal Mass of Incoherent Particles under Gravitational Forces. B. C. Mukerji.** *Zeits. f. Astrophysik*, 15. 1. *pp.* 1–13, 1938. *In English.*—Assuming a slowly rotating flat spheroidal nebula to be constituted of a system of gravitating mass particles exerting negligible pressure and to be of nearly permanent shape, the trajectory of a particle in the internal gravitational field of the nebula has been calculated. It is found that a closed elliptic path of the Newtonian field has up to the order of $\omega^2$, $\omega$ being angular rotation, no tendency to expand but is only subject to a perihelion rotation of amount calculated. AUTHOR.

**1028. Apparent Luminosity of a Receding Nebula. H. P. Robertson.** *Zeits. f. Astrophysik*, 15. 1. *pp.* 69–81, 1937. *In English.*—The radiation field due to a point source in a homogeneous expanding universe is obtained explicitly from the field conservation laws, and is shown to lead to the same expression for the luminosity of a receding nebula as Tolman's corpuscular derivation. This is reconciled with v.

Laue's result without surrender of the orthodox view of the rôle of measuring instruments in general relativity, and disposes of Vogt's criticism of Hubble's use of Tolman's formula. AUTHOR.

*See also* Abstracts 1018, 1050, 1051.

## PLANETS.

**1029. Definitive Orbit of Apollo (Reinmuth Object, 1932 HA). F. L. Whipple and L. E. Cunningham.** *Harvard Coll. Obs., Ann.* 105. *pp.* 537–548, 1937.

*See also* Abstracts 1019, 1071.

## STARS.

**1030. Stellar Magnitudes. F. H. Seares.** *Science*, 87. *pp.* 1–8, *Jan.* 7, 1938.—It is emphasised that stellar magnitude is an observable datum of major importance on which depends our knowledge of the distances of all the more remote celestial objects. Observational difficulties in making satisfactory measurements of brightness are discussed, and the transference of the meaning of the term from physiology to physics is traced. A symbolical expression for the magnitude of a star is given in terms of the logarithm of the energy flux per unit area reaching the earth, modified by certain reduction factors allowing for the filtering effect of atmosphere and optical train and for the fractional response of the receiver. This expression is then used to point out the dangers to which the experimenter is exposed in photometric technique. It is suggested that no photometric investigation be undertaken unless the results are to be reducible to the colour system of the North Polar Sequence. Supplementary magnitude standards are now being determined at Mt. Wilson. A. Hu.

**1031. Spectroscopic Absolute Magnitudes of 370 Southern Stars. D. Hoffleit.** *Harvard Coll. Obs., Ann.* 105. *pp.* 45–68, 1937.

**1032. Photovisual Magnitudes for the Selected Areas at $\delta = +75°$. B. J. Bok and W. F. Swann.** *Harvard Coll. Obs., Ann.* 105. *pp.* 371–381, 1937.

**1033. Photoelectric Magnitude Sequence in the Pleiades. W. A. Calder.** *Harvard Coll. Obs., Ann.* 105. *pp.* 453–458, 1937.

***1034. First List of Objective-Prism Radial Velocities (Fields in Taurus and Cygnus). B. J. Bok and S. W. McCuskey. Notes on Southern Objective-Prism Radial Velocities and on the Absorption Filter. B. Cherry.** *Harvard Coll. Obs., Ann.* 105. *pp.* 327–357, 1937.

**1035. Stream Motions of 85000 Faint Proper-Motion Stars. W. J. Luyten.** *Harvard Coll. Obs., Ann.* 105. *pp.* 397–402, 1937.

**1036. Visual Colour Excess of Bright Stars in Cepheus. K. Graff.** *Akad. Wiss. Wien, Ber.* 146. 2*a*. 3–4. *pp.* 199–202, 1937.—The well-known variable star $\mu$ Cephei, Herschel's " garnet star", has a deep red colour and a spectrum of M2 type. The colour is characteristic of N stars, and those of M type on the contrary often show strong negative colour excess. In order therefore to decide whether the dark nebulosity which involves $\mu$ Cephei affects its colour and that of neighbouring stars, this region was examined in Majorca with a colorimeter of 110 mm. aperture in the winter of 1934–5. The results are summarised in a catalogue of 88 stars of $7^{m}$· and brighter, giving their spectra, colour indices, and

magnitudes. At least fifteen (including 10 B stars) have unusually high colour excess, but they are not confined within the limits of the cosmic cloud, and the rest are normal. The data thus obtained have been compared with Elvey and Mehlin's previous photoelectric measurements of star-magnitudes in this region. M. A. E.

**1037. Colour Estimates of Stars with Larger Instruments. K. Graff.** *Akad. Wiss. Wien, Ber.* 146. 2*a*. 3–4. *pp.* 205–208, 1937.—The author has made visual observations of the colours of stars with several instruments in the years 1902–1928. In the paper he gives a *résumé* of the observations done with the 60-cm. refractor of the Observatory in Hamburg-Bergedorf. The variable stars are excluded from the comparison of the star colours, as determined by the author, with the spectral types of the Draper-catalogue. These relations are shown in three graphs, and it is concluded that the scattering of the observed values is so large that a continuation of these observations cannot be recommended. L. K.

**1038. Henry Draper Charts of Stellar Spectra. A. J. Cannon.** *Harvard Coll. Obs., Ann.* 105. *pp.* 1–20, 1937.

**1039. Effect of Absorbing Clouds on General Absorption Coefficient. J. L. Greenstein.** *Harvard Coll. Obs., Ann.* 105. *pp.* 359–369, 1937.

**1040. Continuous Hydrogen Absorption of White Dwarfs. Y. Öhman.** *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*B*. *No.* 21. [6 *pp.*], 1937. *In English.*—The author has observed with the slitless quartz spectrograph on the 40-in. telescope of the Stockholm Observatory, the white dwarfs (1) van Maanen 1166 ($m = 13{\cdot}5$), (2) Wolf 1346 ($m = 11{\cdot}3$), and (3) A.C. 70°·8247 ($m = 13{\cdot}5$) The photographic energy curves of (1) and (2) are very similar; H$\zeta$ is the last visible Balmer line in both, and there is almost complete absence of continuous H absorption. This also holds good for $o_2$ Eridani B., and may be considered a typical feature of white dwarfs, providing an important clue when searching for them, as the effect is easily observed in low dispersion. He considers the different characterisations of white dwarfs, ordinary A stars and cA stars; also the puzzle of A.C. 70°·8247, which he finds as probably of late F or Go dwarf type though all lines (notably H and K) are abnormally faint and the u.v. spectrum too strong, instead of early B (Kuiper) or A2 (Adams and Humason). He suggests a *Durchmusterung* of u.v. colour indices. A. S. D. M.

**1041. Red Indices of Stars in Eight Southern Selected Areas. C. Payne-Gaposchkin.** *Harvard Coll. Obs., Ann.* 105. *pp.* 383–395, 1937.

**1042. Red Indices in Galactic Clusters. J. Cuffey.** *Harvard Coll. Obs., Ann.* 105. *pp.* 403–444, 1937.

***1043. Astronomical Spectroscopy. A. Hunter.** *Phys. Soc., Reports*, 4. *pp.* 302–310, 1938.—Progress review.

**1044. Minimum Theorem in the Theory of Internal Constitution of Stars. W. Gleissberg.** *Roy. Astron. Soc., M.N.* 98. *pp.* 164–169, *Dec.*, 1937.—The configurations which satisfy the usual equations of radiative equilibrium and possess no central singularities are shown to be obtainable by the variation of a certain integral. The variations are such that the radiation and gas pressures and the radius of the configuration are unchanged. G. C. McV.

**1045. Theory of Pulsations. M. Schwarzschild.** *Zeits. f. Astrophysik*, 15. 1. *pp.* 14–31, 1938.—The author continues his investigation [see Abstract 1109 (1936)] of solutions of differential equations for radial pulsations in such stars as Cepheids. Three different types of solution are investigated. In the first, the boundary conditions of the standard model are satisfied at the limb. This solution demands that the deviation from adiabatic conditions remains negligible at the limb, and is therefore not applicable to observed Cepheids. In the second solution, the pulsating star is surrounded by a thin extended atmosphere, the standing waves of the central core being transmitted outwards in the form of progressive waves in this atmosphere. The amplitudes of such waves cannot, however, be reconciled with observed radial velocity curves. The third solution consists of a standing wave in the central regions gradually taking the form of a progressive wave spreading outwards as the outer layers are reached. Results obtained with the help of the integration machine suggest that such a solution is physically possible. A. Hu.

**1046. Scattering of Light in Stellar Atmospheres. P. Wellmann.** *Zeits. f. Astrophysik*, 15. 1. *pp.* 32–43, 1938.—It is shown that the equations of radiation transfer for a purely scattering model atmosphere generalised from the Eddington approximation can be reduced to Poisson's equation from whatever source the radiation proceeds. An approximate solution is developed for the field of scattered light in an extended, arbitrarily limited atmosphere. The form of the solution found when different shapes are assumed for the atmosphere suggests a possible explanation for the form of the lines in Be spectra. The special case of a star whose photosphere and atmosphere are ellipsoids symmetrical about an axis of rotation, is considered, and numerical examples are worked out in detail. A. Hu.

**1047. Impossibility of Permanent Rotation in a Fluid Star with Elliptical Stratification. P. Dive.** *Comptes Rendus*, 206. *pp.* 99–100, *Jan.* 10, 1938.—A rigorous proof of the theorem is given for the case when the rotation is such that the density at any point is a given function of the pressure. G. C. McV.

**1048. Galactic Structure. Part I. Counts of Stars with Apparent Photographic Magnitudes Brighter than 13·5 in the Southern Hemisphere. E. M. Lindsay and B. J. Bok. Part II. The Milky Way from Aquila to Cygnus. F. D. Miller.** *Harvard Coll. Obs., Ann.* 105. *pp.* 255–326, 1937.

**1049. Space Distribution of White Stars in the Direction of the Galactic Centre. Å. Wallenquist.** *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*A*. *No.* 27. [13 *pp.*] 1937. *In English.*—This investigation concerns the study of about 4300 white stars ($A_3$ or earlier) taken at Lembang (Java). The spectral plates were taken by the Zeiss 15 cm. UV Triplet camera and the photographic magnitude plates with the Zeiss 12 cm. Astro-Tessar camera, mounted on the same axis. The Lembang series are in good focus from H$\gamma$ to far into the u.v. region, and are therefore well adapted for classifying white stars. The photographic magnitudes were used to $mph = 11{\cdot}5$. Tables and figures are given for the percentages of white stars ($B–A_2$), indicating a decrease of white star percentages with increasing apparent magnitude; also the space distribution of stars and curves of space density in the Sagittarius region. The general conclusion is drawn that the brightest part of the great Sagittarius Cloud forms a detached local condensation of stars stretching

from an apparent distance of about 400–500 parsecs to its strongest condensation at about 2000 parsecs, the real galactic centre being (perhaps) concealed by dark strata in the Sagittarius-Ophiuchus regions. A. S. D. M.

**1050. Comparison of Magnitude Sequences in the Two Magellanic Clouds. J. Mohr.** *Harvard Coll. Obs., Ann.* 105. *pp.* 237–240, 1937.

**1051. Photographs of Southern Clusters and Nebulæ. J. S. Paraskevopoulos.** *Harvard Coll. Obs., Ann.* 105. *pp.* 241–242, 1937.

**1052. Position of Three Galactic Clusters in the Hertzsprung-Russell Diagram. L. Gratton.** *Zeits. f. Astrophysik*, 15. 1. *pp.* 48–52, 1938. *In English.*—The position of three galactic clusters in the Hertzsprung-Russell diagram is considered in connection with P. G. Kuiper's hypothesis upon the hydrogen content of clusters [see Abstract 3542 (1936)]. AUTHOR.

**1053. Dynamic Equilibrium of Galactic Clouds. H. Mineur.** *Comptes Rendus*, 206. *pp.* 166–169, *Jan.* 17, 1938.—The gravitational potential of the galaxy at a point within it is considered in conjunction with that of an ellipsoidal galactic cloud around the point. The most general form of the integrated equations of motion of a particle within the cloud is obtained, and the necessary and sufficient conditions formulated that an assemblage of such particles should be in dynamic equilibrium. A cloud obeying these conditions and defined by a generalised law of distribution for its constituent particles is considered to a first approximation as an ellipsoid homogeneously filled with particles. The velocities of the stars at each point are distributed as in a differential rotation around the galactic centre, but with coefficients different from those expected in the absence of the cloud. Two numerical cases are considered: one in which the cloud is comparable to the arm of a spiral nebula, the other in which the cloud is flattened in the galactic plane. The latter bears some points of resemblance to some clouds actually observed. A. Hu.

**1054. Spectrophotometric Study of Nova Ophiuchi 1933 in the Intermediate Stages. A. R. Sayer.** *Harvard Coll. Obs., Ann.* 105. *pp.* 21–43, 1937.

**1055. Masses in Single-Spectrum Binary Systems. H. C. Plummer.** *Roy. Astron. Soc., M.N.* 98. *pp.* 137–153, *Dec.*, 1937.—Aitken suggested that the well-known mass function $m_1{}^3 \sin{}^3 i/(m+m_1)^2$ determined from single-spectrum binaries gives little information bearing on the masses of the systems owing to the disconcertingly wide dispersion the values show. The author takes a different view in regarding the expression as a function of $m \sin^3 i$ and the mass-ratio $f = m_1/m$. Median values of $m \sin^3 i$ for different spectral classes are adopted, and a simple method of deriving $f$ is given, typical results for the different classes being tabulated. The method is also applied to some 250 individual systems, for which comprehensive results are tabulated according to spectral class. The incidence of high and low mass-ratios in the various classes is discussed, and the results compared with those for double-spectrum binaries. The smallest masses for the companions are found in the class B8–G2. There is no clear evidence that bodies smaller than ordinary dwarf stars are involved. In each class the mass-ratios seem to be uniformly distributed. A. Hu.

**1056. Tremblot Spectrograms of β-Lyræ. J. G. Baker.** *Harvard Coll. Obs., Ann.* 105. *pp.* 107–135, 1937.

**1057. Distant Variable Stars in Low Galactic Latitude. H. Shapley and C. D. Boyd.** *Harvard Coll. Obs., Ann.* 105. *pp.* 243–253, 1937.

**1058. Changes of Period in Long-Period Variables. T. E. Sterne and L. Campbell.** *Harvard Coll. Obs., Ann.* 105. *pp.* 459–489, 1937.

**1059. New Eclipsing Star of Unusual Character. M. W. Mayall.** *Harvard Coll. Obs., Ann.* 105. *pp.* 491–497, 1937.

**1060. System of $\alpha$ Ursæ Majoris. H. Spencer Jones and H. H. Furner.** *Roy. Astron. Soc., M.N.* 98. *pp.* 92–111, *Dec.*, 1937.—The available meridian, double-star and radial velocity observations of $\alpha$ Ursæ Majoris have been collected and discussed. Orbital elements have been derived, which give a general agreement with the observations. Attention is called to some discordances and the need for further observations of this interesting system. AUTHORS.

**1061. Peculiar Variable with Changing Period and Light Curve. H. H. Swope.** *Harvard Coll. Obs., Ann.* 105. *pp.* 499–508, 1937.

**1062. Four Peculiar Variable Stars. S. Gaposchkin.** *Harvard Coll. Obs., Ann.* 105. *pp.* 509–520, 1937.

**1063. Asymmetry of Light Curves in the Great Sequence as a Function of Frequency of Period. S. Gaposchkin.** *Nat. Acad. Sci., Proc.* 24. *pp.* 1–4, *Jan.*, 1938.—A characteristic of the Great Sequence (Cluster-type, Cepheid and Long-Period Variables) is that similar curves occur in all constituent star groups; the author uses three parameters for its period-light curve relationships, whose three ratios completely describe it. Two figures are given, based on about 1000 stars. He finds several maxima and minima of period-frequency; maxima lying at about $0^d \cdot 1$ (for Cluster-type) up to $320^d \cdot 0$ (for Long-Periods), and minima similarly from about $0^d \cdot 2$ up to $320^d \cdot 0$ or possibly to $600^d$. Between any two minima, the light-curves run with increasing period from symmetry to asymmetry. Long-Period Cepheids and the Longest-Period Variables show bumps on the Light-curve's rising branch nearer to Longest-Period minimum; Cluster-type Cepheids show no bumps on the rising branch; on the descending branch bumps are all at the same phase. Greatest irregularities are at period frequency minimum. A. S. D. M.

**1064. Complex Variation of DF Cygni. M. Harwood.** *Harvard Coll. Obs., Ann.* 105. *pp.* 521–536, 1937.

**1065. Boss 5442 (V389 Cygni). P. Guthnick.** *Preuss. Akad. Wiss. Berlin, Abhandlungen, No.* 3. [49 *pp.*], 1937.—This is the bright component of Struve's double star 2762 (separation $3'' \cdot 50$), and is a remarkable variable. During observation at the Dominion Astrophysical Observatory, Victoria, from 1918–21, it was found to have a variable radial velocity and was classed as a spectroscopic double with a period of $3^d \cdot 313$, and a spectrum of type B8, in which the lines of the faint spectroscopic companion are not visible. Stebbins in 1923 and 1924 observed its light variations, found them very irregular, and sought in vain for evidence of eclipses. At Babelsberg it has been observed in 1922–4 and 1936–7. From an investigation of all these observations it is established that the star varies with a maximal amplitude of $0^m \cdot 20$ and a normal period of $1^d \cdot 129$, that its light-curve is characteristic of a Cepheid, but that, though the times of normal maximum are always separated by this period or some multiple of it, the normal form and normal amplitude are frequently and markedly disturbed. The light period has apparently no relation to

the spectroscopic period, though it probably belongs to the faint spectroscopic component. If the light-variations are due to pulsation this must be operating with great regularity, but be frequently masked or mastered in its effect on the star's photosphere by some force unknown. The presence of a third component is suggested by rapid changes in the radial velocity. Changes also occur in the intensities and contours of certain lines in the spectrum, and some of these take place in accord with the spectroscopic period of $3^d \cdot 313$; but others do not agree with either the light or the spectroscopic period. Assuming that the faint spectroscopic component is a Cepheid, the absolute magnitude and parallax of Boss 5422 is calculated according to the luminosity-period formula. M. A. E.

**1066. Measures of 1865 A Double Stars. R. G. Aitken.** *Lick Observat., Bull. No.* 491. *pp.* 109–128, 1937.

*See also* Abstracts 1004, 1126.

## SUN.

**1067. Dynamics of Solar Prominences. K. O. Kiepenheuer.** *Zeits. f. Astrophysik*, 15. 1. *pp.* 53–68, 1938.—The characteristics of solar prominences are surveyed and summarised. It is then sought to explain the main characteristics in terms of the effects of three forces: magnetic force, radiation pressure and frictional force. The magnetic force is dependent on the variation of magnetic moment of a sunspot near which induction currents are produced in the ionised gases. The motions of spot-prominences are interpreted in terms of the magnetic interactions. It is assumed that the chromospheric $H_2$ and the quiescent prominences are supported by a permanent radiation pressure and that the eruptive prominences are driven upwards by line emission associated with the bright $H_2$ eruptions. In combination with the compensation of gravitation by radiation pressure the conjectured mechanism of eruptive prominences provides an explanation of the uniform motion and the sudden changes of velocity of these prominences. It is shown that mechanical frictional forces can at the most only influence the motion of prominences in the innermost corona. J. E. K.

**1068. Contours of Coronal Lines. M. Waldmeier.** *Zeits. f. Astrophysik*, 15. 1. *pp.* 44–47, 1938.—It is pointed out that the equivalent breadths of the stronger coronal lines are approximately proportional to their wave-lengths. This suggests the Doppler effect as the cause of the extraordinary breadths. The line contours agree well with the hypothesis of thermal Doppler effect, but a temperature of 660,000° has to be assumed. The author investigates the possibility of explaining the facts by assuming an outward radial streaming of the emitting particles, and neglecting the natural and rotation breadths of the lines. Theoretical contours are derived for streaming velocities of 30, 40, 50, 60 and 70 km./sec. The best agreement is with the 50 km./sec. curve, the deviations from this suggesting that the streaming is not homogeneous. The velocity distribution curve needed to reconcile observed and theoretical contours shows a sharp maximum frequency at 70 km./sec. and a mean at 57 km./sec. The necessity for more observational material is emphasised. A. Hu.

**1069. Spectrophotometry of the Chromosphere, 1932. H. H. Lane.** *Harvard Coll. Obs., Ann.* 105. *pp.* 69–85, 1937.

**1070. Variation of Faint Fraunhofer Lines across the Solar Disc. M. G. Adam.** *Roy. Astron. Soc., M.N.* 98. *pp.* 112–136, *Dec.*, 1937.—Equivalent widths at centre and limb are measured for 94 lines

of Rowland intensity 5 to − 3. It is shown that the ratio of limb equivalent width to centre equivalent width increases regularly with decreasing centre equivalent width, and reaches a value of 1·4 for the − 3 lines. The predictions of existing theories of line formation are examined and found to be unable to account for this strengthening. A " double layer " atmosphere is considered which also fails to fit the observations. The assumption of reduced re-emission in the double layer atmosphere is shown to predict the required strengthening. The interpretation of reduced re-emission for atoms and molecules is considered. AUTHOR.

**1071. Photoelectric Comparison of Brightness of the Sun, Moon, Capella, Vega, and Deneb. W. A. Calder.** *Harvard Coll. Obs., Ann.* 105. *pp.* 445–452, 1937.

*See also* Abstracts 1043, 1092, 1346.

### ZODIACAL LIGHT AND GEGENSCHEIN.

**1072. Origins of the Zodiacal Light. J. Larmor.** *Nature,* 141. *p.* 201, *Jan.* 29, 1938.—In connection with the hypothesis [see Abstracts 3079 and 5280 (1937)] concerning the origin of the zodiacal light, the author directs attention to an error for which he was responsible in reprinting Poynting's Collected Papers, which resulted in doubling the value of the suction of fine orbital dust into the sun. Sir Joseph envisages a nebula-like thick disc around the sun, remains of the original whirling solar nebula, still existing beyond the earth's orbit. This nebula may be considered of the type of the rings of Saturn, only enormously less closely packed. Its particles, as shown by the fact that the zodiacal light shows no scattering effect, must be larger than the wave-length of light. AUTHOR.

## GEOPHYSICS.

### GEOPHYSICS, APPLIED.

**1073. Electrical Vertical Soundings from the Earth's Surface with the Central Induction Method. J. G. Koenigsberger.** *Beitr. z. angew. Geophys.* 7. 2. *pp.* 112–161, 1937. *In English.*—An earlier theoretical study of the central inductive method is continued. The p.d. method can be used for 2 or 3 layers and the resistivity, depth and thickness of the layers found, but for 4 or more layers it is theoretically difficult. The central inductive method is tedious and less accurate to 50 m. than the other method, but it is useful to great depths and less complicated. The advantages and disadvantages of the methods and the conditions common to them are set out. The new results, which support especially two papers of Stefanescu, make possible the calculations of the conductivity and thickness of many layers and an estimate of the limits of error. R. S. R.

**1074. Self-Potentials over Ore-Bearing Beds. A. Belluigi.** *Beitr. z. angew. Geophys.* 7. 2. *pp.* 172–178, 1937.—Attention is drawn to the production of self-potentials and to the methods of their measurement and survey. Calculation is made of the theoretical value of the potential at the earth's surface produced by natural electrical fields which are due to electrochemical processes. The mathematical theory of Edge and Laby

is developed and applied more closely to the real case, and some practical consequences are drawn. J. J. S.

*See also* Abstract 1108 and
1017B. Short Waves in Radio Geology. V. Fritsch.

## HYDROSPHERE, PHYSICS OF THE.

**1075. Light in the Sea. A. Puppo.** *Ricerca Scientifica*, 2. *pp.* 509–521, *Nov.*, 1937.—A report is given of the value and methods of studying the absorption of light by sea water. The extinction of the light is caused by direct absorption, giving energy to the mass of water, by diffusion due to water molecules and suspended matter and by reflection at the air-liquid surface. The diffusion especially is known to be a function of the wave-length of the light and experiments on pure water and sea-water show that in all cases the least extinction occurs in the region blue-green. Photographic, thermoelectric and photoelectric methods are used in lakes and oceans to measure the extinction factor, in most cases testing different spectral regions by filters, but, in some using sub-aqueous spectrometers. Results show how varied the amount of absorption is, even at places as near one another as Venice and Trieste. H. M. B.

***1076. Marine Current Meter. M. Tenani.** *Com. Geod. e Geofis., Boll.* 7. *pp.* 133–143, *July*, 1937.—A new form of current meter is described and illustrated. It can be used in the open sea and registers automatically both the velocity and direction of the current. W. A. R.

**1077. Prevalent Periods of Oscillations in Tidal Waves. K. Sezawa and K. Kanai.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 888–898, *Dec.*, 1937. *In English.*—The mathematical method previously described [see Abstract 5285 (1937)] is applied to the present case in which the relation between the length of an earthquake tidal wave and sea depth ($\eta$) is discussed. It is concluded that the large amplitudes of the tidal waves of the earthquake of 3 March, 1933, were generated from an original of relatively small area and that their velocity was less than $\sqrt{\eta g}$. C. A. S.

## LAND, PHYSICS OF THE.

*See* Abstracts 1107, 1122.

## METEOROLOGY.

***1078. Solar Radiation Between 2000 and 3000 Å. K. O. Kiepenheuer.** *Zeits. f. Astrophysik*, 14. 5. *pp.* 348–356, 1937.—A limit to observation of celestial short-wave radiation is set by the absorption of atmospheric ozone, which begins at about 3000 Å, has a maximum at 2500, then a steep fall to 2000; and this is combined with atmospheric oxygen absorption below 2700 Å. At mountain heights the latter becomes much less, and several attempts have been made by different observers to find evidence of solar radiation at about 2150 Å in the so-called ozone-oxygen gap. Meyer, Stein, and Stoll, in 1934 on the Jungfrau, using a monochromator and photon-counter, and more recently Mohler without monochromator, believed they had found radiation in this gap. Their results, however, are not entirely convincing, in this difficult region of the extreme ultra-violet. The observations were therefore repeated on the Jungfrau in July and August, 1937, with photon counter and double

monochromator, aluminised mirrors, and special precautions to exclude scattered light. When the monochromator slits were made very narrow, less than 0·1 mm., no radiation at all was registered between 2000 and 2400 Å, even with the sun at its greatest altitude. The shortest wave-length observed with certainty was 2845 Å. The methods of observation and the specially constructed photon counters are described and figured. M. A. E.

***1079. Radiometric Measurements of U.V. Solar Intensities in the Stratosphere. R. Stair and W. W. Coblentz.** *Bureau of Standards J. of Research*, 20. *pp.* 185–215, *Feb.*, 1938.—A description is given of a photoelectric cell and filter type of u.v. intensity meter which is combined with an audio-frequency generator and radio transmitter and transported aloft by means of unmanned balloons. The radio-frequency wave is modulated by the response of the photoelectric cell, the response being proportional to the intensity of the incident u.v. rays. The height of the balloons is indicated by a radio barograph. The radio signals giving the altitude of the apparatus and the u.v. intensities are received and recorded graphically at a ground station. Six balloon ascensions were made during the latter part of June and the early part of July, 1937. Altitudes up to about 80000 ft. (24 km.) were attained, but owing to the weakness of the signal and the consequent interference by noise strictly quantitative data were obtained only to about 64000 ft. (19 km.). Below 14 km. the u.v. transmissions through the filters remain fairly constant, indicating but little change in the spectral quality of the shortest wave-lengths. At a height of about 14 km. the transmissions of the filters begin to decrease, indicating a selective increase in u.v. intensity of the shortest wave-lengths as a result of a decrease in the amount of ozone above the apparatus. Between 14 and 19 km. the filters show an unmistakeable decrease in transmission, indicating that the apparatus had passed through an appreciable portion of the ozone layer, variously estimated at 15 to 30% of the superposed ozone, the lower value being in good agreement with previous explorations (in 1934), taking into consideration the latitude and the season of the year. At the highest altitudes attained the u.v. intensity in the band of wave lengths shorter than 3132 Å was about 3 times the value observed at sea level. This spectral band includes, of course, also wave-lengths not observed at sea level. AUTHORS.

**1080. Determination of Height and Energy Relationships by Means of the 'Emagram.' H. Arakawa.** *Gerlands Beitr. z. Geophys.* 51. 4. *pp.* 321–324, 1937.—In this diagram, a linear temperature scale is plotted against a logarithmic pressure scale. From this the geopotential difference for dry air can be found, as $\phi_1 - \phi_0 = \mathrm{RT}_e (\log p_0 - \log p_1)$. A table is constructed according to this formula which gives pressure values and heights in dynamical metres above the 1100 mb. level for an isothermal atmosphere. The case of a moist atmosphere is also treated. Further, by considering the areas on the emagram quantitative values of the energy relationships can be obtained. It enables the difference between the pseudo geopotential and the actual geopotential to be found, so that the stability of the air mass may be determined. A copy of the diagram is appended. A. E. M. G.

**1081. Extent of, and Temperature Arrangement within, a Vertical Temperature Circulation. A. Wagner.** *Gerlands Beitr. z. Geophys.* 51. 4. *pp.* 410–421, 1937.—On considering how the air present in the thermal circulation arising according to the scheme suggested by

Hann, is affected by that outside it, then many difficult questions arise. In dealing with these the author shows that in the free atmosphere divergence occurs over warm sources and convergence over cold regions. From these, vertical currents arise. In a stable atmosphere cooling or warming is also bound up with these vertical movements. Now Exner has shown that in a stable stratified atmosphere a vertical circulation in a closed system is not possible. The rising air must in consequence mix non-adiabatically in a horizontal direction with other air masses. So the thermal effect of the vertical movement will decrease with height and finally disappear at the upper limit of the thermal circulation. Hence the low temperatures of the stratosphere above the tropics arise in consequence of the dynamical processes just referred to. Also when the circulation is strongly developed, as over the tropics then its upper limit is not at the tropopause but reaches considerably higher. A. E. M. G.

**1082. Advective-Dynamical Theory of Pressure Changes and Their Periodicity. B. Haurwitz.** *Gerlands Beitr. z. Geophys.* 51. 4. *pp.* 422–425, 1937.—Ertel's theory of pressure variation [see Abstract 554 (1936)] is summarised and a mathematical expression representing the results is given. The author then proceeds to examine under five heads the conclusions arrived at by Ertel. Further, it is shown that the relationships discussed are entirely different from those in the resonance theory of the half-day barometric pressure variation. Whether Margules' explanations of the half-day pressure wave is correct or not is entirely unimportant in the present case. For in Ertel's work such resonance questions are not treated. A. E. M. G.

**1083. Physical Interpretation of Weather. E. W. Woolard.** *J. of Applied Physics*, 9. *pp.* 5–15, *Jan.*, 1938.—Though the weather is essentially a dynamical and thermodynamical phenomenon, yet great difficulty is encountered in attempting the systematic development of meteorology entirely on principles of physics. As the standard method of representing weather conditions is by the synoptic chart, the introduction of this method together with the information obtained regarding the movement and behaviour of air currents at different temperatures is reviewed. The author points out how the investigation in detail of the separate currents led to much information being obtained regarding the detailed structure of cyclones. Thus the movements and modifications of air masses are traced and their relations to attendant weather phenomena. Now as air masses by their physical characteristics may be classified into polar and tropical, so to interpret synoptic charts information regarding conditions up to considerable heights is required. The methods of obtaining and interpreting this information are discussed at length, and the aid afforded to the purely empirical method of forecasting by this method of analysis is emphasised. A. E. M. G.

**1084. Instability From Water Vapour. C. W. B. Normand.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 47–66; *Disc.*, 66–69, *Jan.*, 1938.—This paper summarises the general criteria for the stability of a particle and of a layer in the atmosphere under conditions when condensation may bring the latent heat of water vapour into play. It discusses briefly the relationship between *Feucht-Labilität* (Refsdal), latent instability (Normand) and convective instability (Rossby), and gives the reasons for the introduction in India of the classification based on latent instability. The conditions for latent instability are defined with the aid of the tephigram, and an example is given to show how by generating latent instability within a

closed system, *e.g.*, by raising the wet-bulb temperature in the lower layers and leaving all else unchanged, the energy available for transformation into kinetic energy may rise from zero to the equivalent of a wind of 50 mi./hr. throughout the system, without taking account of the energy that may become available from the evaporation of rain-drops, in descending air. If, however, evaporation from rain-drops takes place in the descending air in a thermodynamically efficient manner, the available energy in the closed system of the chosen example is nearly trebled, *i.e.*, the equivalent average velocity rises to more than 90 m.p.h. AUTHOR.

**1085. Kinetic Energy Liberated in an Unstable Layer. C. W. B. Normand.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 71–74, *Jan.*, 1938.—Kinetic energy is released when an unstable super-adiabatic layer of constant lapse-rate $\epsilon\Gamma$ rights itself (where $\Gamma$ is the adiabatic lapse-rate and $\epsilon > 1$). The average kinetic energy can be computed analytically by Margules' method or graphically on the tephigram. By Margules' method a good approximate formula for the resulting average velocity is shown in this paper to be $v = \text{constant} \times \Delta p/\Pi \{ (\epsilon - 1) \Theta \}^{\frac{1}{2}}$, where $\Pi$ and $\Theta$ are the mean pressure and temperature of the column and $\Delta p$ is the pressure difference between the top and bottom of the column. The method of the tephigram gives the average energy to be equivalent to one-sixth the area of a parallelogram of which the diagonals are the initial and final temperature curves of the column. Some examples are numerically evaluated by these methods and the results show close agreement with values previously calculated by a longer and more laborious method by Littwin. AUTHOR.

**1086. Importance of Vertical Motion in Development of Tropical Revolving Storms. C. S. Durst and R. C. Sutcliffe.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 75–82; *Disc.*, 82–84, *Jan.*, 1938.—The problem discussed is that of the mechanism for the eviction of air from tropical revolving storms. By the examination of the equations of motion it is found that this eviction could be explained by the upflow of air from layers of greater velocity to those of less velocity. A proposition which may have important applications to many other problems is enumerated. AUTHORS.

**1087. Mechanics of the Depression. C. J. Boyden.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 85–91; *Disc.*, 92–95, *Jan.*, 1938.—Attention is called to certain serious gaps and obscurities in our understanding of the birth and development of the depression. The paper concludes with a discussion of the effect of isobaric curvature on wind speeds in different parts of the depression, and the resulting convergence and divergence. AUTHOR.

**1088. Ice Formation in Clouds in Great Britain. W. H. Bigg.** *Meteorolog. Office, Prof. Notes.* 6. *No.* 81. [35 *pp.*], 1937.—The physical processes involved are investigated by dealing with (*a*) direct deposition of ice as crystals, snow or hail, (*b*) freezing on aircraft of water drops in rain or cloud, and (*c*) sublimation on aircraft. The distinctive features of glazed frost, rime and hoar frost are next treated. The ice formation in all types of cloud except cirrus has been treated by a very full analysis of many cases by considering the temperature range, the rate of deposition, and the frequency of each type associated with these clouds. Full details of many cases are set out in a table. The importance of the size of drop in the cloud and the cloud's state of growth or decay are shown. Observations at Ben Nevis lead to confirmatory results. Examples are given and discussed where ice formation was associated with fronts. The sea-

sonal and local distribution of the conditions are shown in a table. The effects on an aircraft of ice formation are discussed and finally various methods of prevention and dispersal of the deposits are examined. R. S. R.

**1089. Ice Accretion on Aircraft. G. C. Simpson.** *Meteorolog. Office, Prof. Notes,* 6. *No.* 82. [14 *pp.*], 1937.—The physical changes in the atmosphere which may give rise to ice accretion are discussed and the types of hoar frost, rime and glazed frost are distinguished. Meteorological conditions involving cloud formation, precipitation, and the range of temperature, and their seasonal variation, are next considered. Rules are given by which the dangerous conditions may be avoided. Finally meteorological situations in which ice accretion occurs are discussed.

R. S. R.

**1090. Theory of Hailstone Formation. T. E. W. Schumann.** *Roy. Meteorolog. Soc., J.* 64. *pp.* 3–17 ; *Disc.*, 17–21, *Jan.*, 1938.—A fairly detailed mathematical analysis is presented of the generally accepted theory that the formation of large hailstones is due to the capture of undercooled water drops which lie in their path. It is shown that the principal factors which determine the ultimate size of a hailstone are its average density, the height at which its nucleus is formed, the average upward velocity of the air and the concentration of condensed water in the region of the atmosphere where the temperature is below 0°C. The interrelation between these various factors is shown by means of a number of curves. It is further demonstrated that the values of water content of the clouds and of upward air velocities, measured or deduced independently, are sufficient to account for the formation of hailstones at least 8 cm. in dia. The matter of the disposal of the latent heat of the water which solidifies on the surface of the hailstone is also examined in some detail, and it is shown that this heat is disposed of quite effectively, partly by conduction to the surrounding atmosphere and partly by evaporation from the surface of the hailstone. Only in the case where the surface temperature of the hailstone approaches 0°C. does its incapability to get rid of its surplus heat act as a factor retarding its rate of growth, and consequently its ultimate size. AUTHOR.

**1091. Evaporation of Falling Drops. N. Frössling.** *Gerlands Beitr. z. Geophys.* 52. 1–2. *pp.* 170–216, 1938. *English Abstract.*—The drop was placed on a thin glass rod or a thermo-element, and an air-current from a wind-tunnel was blown from below. The evaporation was measured by photographing the drop repeatedly on increased scale. The radius of the drop was 0·1–0·9 mm., the wind-velocity 0·2–7 m./sec., and the Reynolds number 2–800. Nitrobenzene, aniline and water were examined. From the measurements the following formula was obtained, in agreement with the theory : $dm/dt = 4\pi\Delta\,(Mp/RT)\cdot r(1 + k\sqrt{Re})$. $dm/dt$ = evaporation in gm./sec. ; $\Delta$ = diffusion constant in cm.$^2$/sec. ; $M$ = molecular weight ; $R$ = the universal gas constant ; $T$ = absolute temperature ; $p$ = difference between the pressures of vapour at the surface (approximately the saturation pressure) and in the streaming air ; $r$ = radius of the drop ; $Re$ = Reynolds number = $\rho U\cdot 2r/\eta$; $\rho$ = air-density ; $\eta$ = air-viscosity ; $U$ = relative velocity ; (all quantities in c.g.s. units). $k$ is a constant characteristic for the evaporating substance that only depends on $\sigma = \Delta/\nu$. ($\nu = \eta/\rho$). At least approximatively $k = 0\cdot 276/\sqrt[3]{\sigma}$. For the evaporation of naphthalene spheres the same result was obtained. The fluid-drops could therefore, in the examined range, be treated as solid spheres. For naphthalene the evaporation in different

zones could be measured. The results of these measurements agree well with those derivable qualitatively from the stream shape. AUTHOR.

**1092. Solar Activity and Haloes. H. Neuberger.** *Gerlands Beitr. z. Geophys.* 51. 4. *pp.* 343–364, 1937.—From a careful examination of the problem from every point of view, the author concludes from observations made by Visser and also by himself that no 27-day period in halo frequency can be found. The problem can be approached by an examination of the international magnetic character figures E. Such an investigation gives results as regards sunspots and haloes very similar to those obtained by Visser. By a second method of investigation the author concludes that the solar influence on halo frequency is about one day later than the magnetic activity, and on the average three days later than the sunspots. Relations between haloes and solar activity is definitely weak, and therefore the author concludes that cirrus must be regarded as the factor on which alone haloes depend. Numerous diagrams and tables are given throughout the paper. A. E. M. G.

**1093. Position of the Auroral Zone. D. Barbier.** *J. de Physique et le Radium*, 8. *p.* 512, *Dec.*, 1937.—Since it is necessary that the electrons emitted by the sun reach the ionosphere with a velocity greater than $10^{10}$ cm./sec. and that the auroral zones are about 20° from the magnetic poles, it is known that the earth's magnetic field alone is unable to account for the facts. By introducing a terrestrial electric field a velocity of $10^{10}$ cm./sec. gives a value of 1·3° to the auroral zone, which, together with other considerations, shows that the addition of the terrestrial field is insufficient to explain the position of the zone. H. M. B.

**1094. Yellow Radiation of the Night Sky. J. Cabannes and J. Dufay.** *Comptes Rendus*, 206. *pp.* 221–224, *Jan.* 24, 1938.—Previous determinations of the wave-length of the yellow radiation by various observers having given rise to different results, the present authors have re-determined the wave-length and obtain 5894 ± 1 Å. The observations were made at Montpellier during 1935–36–37. The origin of the radiation is ascribed to Na in the upper atmosphere on the hypothesis that the $D_1$ line of Na (5895·9 Å) is there at least as strong as the $D_2$ line (5890·0 Å). A real difference in structure was observed between the line of the yellow radiation and that of the green auroral line (5577 Å). G. C. McV.

***1095. Pilot Balloons and Sources of Light for High-Altitude Upper-Wind Observations. W. H. Wenstrom.** *Monthly Weather Rev.* 65. *pp.* 326–331, *Sept.*, 1937.—The observations cover a period from Dec. 1934 to Sept. 1937, and deal with heights from 15000 to 40000 ft. The results obtained with various types of balloon from the 6-in. to the 16-in. are described, particular attention being given to results with the 16-in. type. For night observations the sources of light used consisted of a single candle or of clusters of candles up to eight, or of a small electric light. These were placed in a white paper lantern and attached to the balloon. Another source was the acetylene light in which the acetylene gas was stored in an auxiliary balloon. Pyrotechnic flares were also tried and suggestions are given for improved types. As a result of the investigation it appears that the 16-in. balloon is the only dependable type for high altitudes and that at great heights double theodolite observations are desirable. A network of high-altitude wind observation stations for the United States is suggested. Photographs of the 16-in. type of balloon and of the light source are reproduced. A. E. M. G.

*See also* Abstract 1185.

## SEISMOLOGY.

**1096. Deep-Focus Earthquakes and Anomalies of Terrestrial Magnetism and Gravity. S. W. Visser.** *Terr. Mag.* 42. *pp.* 361–362, *Dec.*, 1937.—A map of the world contains data of the anomalies of the vertical component and the principal deep-focus regions. Anomalies of gravity are also noted. It is suggested that the three effects may have a common origin in the current systems of the inner earth. Large current systems must be present in the earth's interior, downwards below the oceans and upwards below the continents. G. E. A.

**1097. Rayleigh Waves. K. Sezawa and K. Kanai.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 845–859, *Dec.*, 1937. *In English.*—Rayleigh waves of shallow origin are treated, and the results probably apply to any condition of the subjacent medium. The amplitude of the surface waves assumes a maximum for two cases. W. A. R.

**1098. Elastic Stability of the Earth. K. Sezawa and K. Kanai.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 860–877, *Dec.*, 1937. *In English.*—The problem is attacked by means of polar coordinates. It is considered that traces of certain past states of instability of the earth should be pronounced. [See following Abstract.] W. A. R.

**1099. Plastic State of the Earth under Gravitational Forces. K. Sezawa.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 878–886, *Dec.*, 1937. *In English.*—Following on previous work [see preceding Abstract] the effect of plastic conditions of the earth is examined. The conditions under which the shell and core are plastic are discussed. Considerations of the plastic equilibrium of the earth enable conclusions to be drawn as to the difference between shallow- and deep-focus earthquakes. W. A. R.

**1100. Origins of Earthquakes. W. Inouye.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 954–964, *Dec.*, 1937. *In English.*—The calculations and conclusions previously arrived at [see Abstract 594 (1937)] are revised, and the conclusion now derived is that nothing absolutely certain can be said regarding the length of dilatational waves, but that it is probable that their length is comparable with the size of the origin. C. A. S.

**1101. Supposed Regional Variations in Travel Times. B. Gutenberg.** *Seismological Soc. of America, Bull.* 27. *pp.* 337–346, *Oct.*, 1937.—An investigation of the Tango earthquake of March 7, 1927, shows that travel times for P observed in that shock agree within the limits of error of one or two seconds with the travel times found for other earthquakes and that thus far there is no indication of differences beyond the limits of observational errors between the travel-times curves of earthquakes in different regions. This statement, however, does not include the travel times to short epicentral distances of a few degrees found in various regions which are influenced by the local structures in those regions, and especially not to the travel times found from waves which have traversed only the uppermost parts under the Pacific Ocean. AUTHOR.

**1102. Royal Society Expedition to Montserrat, B.W.I. Final Report. C. F. Powell.** *Roy. Soc., Phil. Trans.* 237*A*. *pp.* 1–34, *Feb.* 7, 1938.—[See also Abstract 597 (1937).]

*See also* Abstracts 1020, 1077.

## TERRESTRIAL ELECTRICITY AND MAGNETISM.

**1103. Exploration of Electric Fields in Clouds. F. J. W. Whipple.** *Nature*, 141. *pp.* 143–145, *Jan.* 22, 1938.—The problem discussed is the determination of the situation of the electrification in clouds, the method of approach being that suggested by Simpson and Scrase [see Abstract 3499 (1937)]. The necessary observations were carried out at Kew. These consisted of finding the sign of the potential gradient at different heights. A description of the method employed is given. An analysis of the records obtained shows that (1) practically in every ascent there is a change in the sign of potential gradient; (2) the location of the charges is related to the temperature of the cloud. A diagram illustrates the conclusions. The investigation reveals that positive electrification is developed in the part of the cloud where snow is, and the complementary charge near the bottom. This is in agreement with observations made on driving snow near the ground. The values found so far for the magnitude of the potential gradient are comparatively low and as such would not account for the quantities of electricity hitherto supposed to be discharged by a lightning flash. It is hoped that control measurements will be made to test this. The investigation is being continued. A. E. M. G.

**1104. Distribution of Electricity in Thunder Clouds. B. Walter.** *Ann. d. Physik*, 31. 2. *pp.* 177–180, *Jan.*, 1938.—The theory developed in Simpson and Scrase's paper [see Abstract 3499 (1937)] is criticised. Evidence by Hann is quoted to show that the temperature throughout the cloud is not below 0° C. It is considered that the temperature is maintained by the latent heat evolved during condensation and by the absorption of solar radiation, numerical values being given. Ice needles will occur only in the top of the cloud. The criticism of the Wilson influence theory, by assuming that rapidly falling breaking drops are observed, is considered to be wrong in that only ice needles or plates exist there and these fall slowly and cannot by their shape and growth give induced charges. R. S. R.

**1105. Point-Discharge Currents during Thunderstorms. M. N. S. Immelman.** *Phil. Mag.* 25. *pp.* 159–163, *Jan.*, 1938.—With a microvoltameter similar to that used by Wormell at Cambridge a record of point-discharges during thunderstorms was kept at Pretoria, South Africa. The pole on which the discharge-point was mounted was about 7 m. high, and was in the centre of an empty field. A record of observations is given. For the two seasons for which the records are complete there was a net transfer of + electricity from the earth to the atmosphere amounting to 185 mC for the two. Leaving out discharges during dust-storms the results show a net loss of + electricity of 65 mC for the 1933–1934 season and 57 mC for the 1936–1937 season. J. J. S.

***1106. Recording of Atmospherics and the Forecasting of Storms. R. Faillettaz.** *Comptes Rendus*, 206. *pp.* 270–271, *Jan.* 24, 1938.—The principle of the apparatus used and some results obtained with it at Tamanrasset have already been published [see Abstract 1087 (1935)]. The present observations were made on short wave-lengths at Trappes and show that satisfactory registrations can be got even in the vicinity of radio stations and in places far distant from tropical storms. The conclusions arrived at regarding the propagation and diurnal variation of the activity of atmospherics from an examination of the recordings, are set out in detail. As regards forecasting the investigations carried out

in the summer of 1937 reveal the distances at which a storm may be detected during the day or the night. The direction of the storm can also be determined to the four principal points. Modifications are being made in the instrument with a view to higher sensitivity for both distance and direction in the day time. A. E. M. G.

**1107. Demagnetising Action of Changes in Earth's Magnetic Field. H. Schmidlin.** *Beitr. z. angew. Geophys.* 7. 2. *pp.* 94–111, 1937.—Experimental tests were made to determine the varying effects of alternating magnetic fields on the remanent magnetisation of rocks, particularly pre-tertiary igneous rocks. The effects of changes of frequency, time of application, pretreatment and magnetic viscosity are described. It is found that the small remanent magnetisation of rocks cannot be explained as an effect of the oscillations occurring in nature. The loss of remanent magnetisation of the pre-tertiary rocks, and partially, the secular variation, can be due to heat, vibration, or alternating magnetic fields. R. S. R.

**1108. Field Strength and Current Density of a Dipole in the Earth's Surface. G. de Niem.** *Beitr. z. angew. Geophys.* 7. 2. *pp.* 162–171, 1937.—Mathematical expressions are obtained for the potential, electric field intensity, current density and specific resistance for the cases of two electrodes at infinite and finite distances apart. The field vectors of each pole are found to decrease with the square of the distance and to add geometrically. The decrease of field strength and current density with depth as a consequence of current displacement is shown graphically. R. S. R.

***1109. Marsch Compass with Vortex Flow Damping. K. Martin.** *Zeits. f. techn. Physik*, 18. 11. *pp.* 462–463, 1937.—The ordinary Marsch compass had a very long inconvenient time of coming to rest. Recent patterns removed this defect by using liquid damping but with the retardation of the liquid capsule it is not guaranteed unconditionally. A new pattern is described and diagrams given in which a quite short compact rectangular magnet made of material with high coercive power and employing vortex flow damping gives a time of coming to rest still less than that of the liquid compass. R. S. R.

**1110. Summary of the Year's Work, Department of Terrestrial Magnetism, Carnegie Institution of Washington. J. A. Fleming.** *Terr. Mag.* 42. *pp.* 399–406, *Dec.*, 1937.—A magnetic effect of the diurnal-variation type has been associated with a definite region of the ionosphere. The simultaneity of fade-out, magnetic and earth-current effects with solar outbursts in the region of sunspot areas has been confirmed by direct observation at Huancayo. It was also shown that a magnetic storm can produce world-wide changes in cosmic-ray intensity. At Huancayo the lunar influence on variations of the earth's magnetism is so great that it may be noted in a single day's record. The Department began, in March, 1937, to issue weekly bulletins on the state of the earth's magnetic field in the U.S.A. which are useful as supplying advance estimates of radio-transmission conditions. Data relating to atmospheric electricity are being compiled which may assist in forming conclusions as to the source of the current which charges the earth, and as to the manner in which the earth acquires and maintains a negative charge on the surface where fair weather prevails. It is found that water vapour combines with large ions which then become more efficient in removing the small ions in the atmosphere. Data show a high correlation between size of the large ion

and absolute humidity. Work on radioactive material in the atmosphere indicates that a large part of the radioactivity produced in the lower atmosphere is positively charged. There is a probability that the presence of nuclei reduces the atmospheric conductivity, their effectiveness increasing with the altitude. A light radio-transmitter with Geiger counter was constructed which, when carried up in a sounding balloon, sent out a signal when a cosmic-ray corpuscle passed through the counter. At intervals it also sent signals which indicated the altitude of the balloon. Further attention has been given to the variation of the diurnal range in earth-currents during the sunspot cycle, and to the lunar diurnal variation in earth-currents. In the ionosphere, the increase of ionisation of all regions with the advance of the sunspot cycle was pronounced. Measurements show that reflection of radio waves from the E-region is primarily due to electrons. An automatic multifrequency ionospheric recorder has been completed which records the virtual height of waves of given frequency range, and rapid ionospheric changes can be followed in detail. In nuclear physics further measurements have been made on the "new" physical force which binds protons and neutrons, and the construction of an atomic physics laboratory was begun in May, 1937. The section of land magnetic survey continues its activity in different parts of the globe. Work at the observatories and oceanographic reductions are also reported.

G. E. A.

*See also* Abstracts 1096, 1145.

## RADIOACTIVITY.

**1111. Artificial Disintegration and Radioactivity. G. Guében.** *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 238–283, *Dec.* 31, 1937.—A review of experiments carried out on artificial disintegration of nuclei, and radioactivity during 1936 and early 1937. A table of results of nuclear reactions investigated, and a Bibliography are given. A. J. M.

**1112. Oppenheimer-Phillips Process (Nuclear Reactions). H. A. Bethe.** *Phys. Rev.* 53. *pp.* 39–50, *Jan.* 1, 1938.—An examination is made of the mechanism proposed by Oppenheimer and Phillips [see Abstract 4045 (1935)] for the disintegration of nuclei by deuterons with proton emission (the *d-p* reaction). A formula is derived which expresses the probability of this process in terms of the penetrability of the potential barrier and the sticking probability of the neutron, which latter is found to give, directly, the energy distribution of the emitted protons. The probability of the O-P reaction is compared with that of ordinary nuclear reactions. The O-P reaction is found to prevail in the *d-p* reactions for nuclear charges of about 25 and higher. The question of secondary disintegrations following the *d-p* reaction is discussed and it is decided that such disintegrations should be rare for deuteron energies below the top of the potential barrier. G. O. B.

**1113. Nuclear Selection Rules. C. D. Ellis.** *Phys. Soc., Proc.* 50. *pp.* 213–216, *March* 1, 1938.—Experiments have been made to determine the intensity of a $\gamma$-ray of 3·2 eMV, suspected to be emitted by ThC″—Th.Pb, by comparing the number of recoil protons from deuterium with those due to the well known $\gamma$-ray of 2·62 eMV. It appears most probable that between 1 and 3 quanta are emitted in every 100 disintegrations. This result is shown to lend support to the view that it is practicable to

assign to the various nuclear states experimental spin values which can be used consistently in different sets of selection rules. AUTHOR.

**1114. Radiations Emitted from Artificially Produced Radioactive Substances. Part IV. $\gamma$-Rays from Several Elements. J. R. Richardson.** *Phys. Rev.* 53. *pp.* 124–127, *Jan.* 15, 1938.—Further studies on the $\gamma$-radiation from $V^{48}$, $N^{13}$, $Cu^{64}$, $Mg^{27}$, and $Na^{24}$ have been carried out using a large hydrogen-filled cloud chamber and with several improvements in technique. The most striking feature of the spectra is the presence of a large amount of 1 eMV radiation from $V^{48}$. Comparison with the ordinary annihilation radiation indicates that there are four 1 eMV quanta emitted per positron. The possible origin of this radiation is discussed. A difference in the $\gamma$-radiation emitted from $N^{13}$ and $Cu^{64}$ is noted, the latter having a more pronounced high energy tail. A small number of tracks from $Mg^{27}$ have been measured and indicate a monochromatic line at $0{\cdot}88 \pm 0{\cdot}05$ eMV. The radiation from $Na^{24}$ has been re-examined. The results indicate that the quantum energy of the high energy line is $3{\cdot}00 \pm 0{\cdot}05$ eMV. The two other lines with energies of 2 eMV and 1 eMV are confirmed. [For Part III see Abstract 967 (1937).] AUTHOR.

**1115. Neutrons from Lithium Plus Deuterons. W. E. Stephens.** *Phys. Rev.* 53. *pp.* 223–226, *Feb.* 1, 1938.—The energy distribution of the neutrons from the disintegration of Li by deuterons has been measured by the method of $\alpha$-recoils in a He-filled high pressure cloud chamber. The stopping power was calibrated with Th C′ $\alpha$-particles in the chamber. Two distinct groups of neutrons were found with disintegration energies of $15{\cdot}05 \pm 0{\cdot}2$ eMV and $11{\cdot}8 \pm 0{\cdot}4$ eMV. The 15·05 eMV group is attributed to the formation of $Be^8$ in a normal state and the 11·8 eMV group to the formation of $Be^8$ in an excited state of about 3·3 eMV with a width at half-maximum of about 1·5 eMV. A more or less continuous distribution was observed from 9 to 3 eMV (the limit of observation). These neutrons may come from higher wider states of $Be^8$. AUTHOR.

**1116. Slow Neutron Disintegration of $B^{10}$ and $Li^6$. M. S. Livingston and J. G. Hoffman.** *Phys. Rev.* 53. *pp.* 227–233, *Feb.* 1, 1938.—The disintegration of $B^{10}$ by slow neutrons is found to result in two groups of $\alpha$-particles, of ranges $0{\cdot}80 \pm 0{\cdot}03$ and $0{\cdot}66 \pm 0{\cdot}05$ cm. and with relative intensities 1 : 3, corresponding to disintegration into the ground state of the $Li^7$ product nucleus and the 0·44 eMV excited state, respectively. The reaction energies obtained from these ranges with the best available range energy relation check well with those computed from atomic masses if a mass of $B^{10}$ is used which is consistent with other nuclear disintegrations. The slow neutron disintegration of $Li^6$ results in $H^3$ particles of $5{\cdot}90 \pm 0{\cdot}06$ cm. range, indicating a reaction energy of 4·86 eMV. This is in disagreement with the value obtained from atomic masses and suggests errors in the mass values or the proton range energy relation. Techniques for the measurement of very short particle ranges are described, including methods for the determination of the depth of penetration into the recording ionisation chamber. AUTHORS.

**1117. Photodisintegration of the Deuteron by the $\gamma$-Radiation from $Na^{24}$. J. R. Richardson and L. Emo.** *Phys. Rev.* 53. *pp.* 234–239, *Feb.* 1, 1938.—The photodisintegration of the deuteron by the $\gamma$-radiation from radioactive $Na^{24}$ has been observed in a cloud chamber filled with $D_2$ at a pressure of 1 atm. A sample of NaF was activated by deuteron bombardment in the cyclotron to a $\gamma$-ray strength equivalent

to about 12 mg. of Ra, and was then brought close to the cloud chamber. Pictures were taken with a stereoscopic camera. Of the 100 proton tracks observed on 5000 pictures, only 42 were deemed suitable for range measurement, although the angular orientation of 61 could be determined. The range distribution of these tracks indicates a mean air equivalent range of 4·4 mm., corresponding to a mean energy of 410 kV for the photo-protons. This indicates that the difference between the energy of the $Na^{24}$ $\gamma$-ray and the binding energy of the deuteron is 820 $\pm$ 35 kV. Since the new range energy relation for slow protons has thrown doubt upon the binding energy of the deuteron, we can use the value of 3·00 $\pm$ 0·05 eMV obtained by the Compton recoil method for the energy of the $\gamma$-radiation from $Na^{24}$, and obtain 2·18 $\pm$ 0·07 eMV for the binding energy of the deuteron. The angular distribution of the tracks indicates that the disintegration is predominantly photoelectric, although a small contribution from the photomagnetic effect is not ruled out. A rough calculation from the yield of tracks indicates a cross-section for the disintegration of $1 \times 10^{-27}$ $cm^2$. The possibilities of the method for the determination of the energy of strong $\gamma$-radiation is discussed. AUTHORS.

**1118. Range of Thorium $\alpha$-Rays. J. Schintlmeister.** *Akad. Wiss. Wien, Ber.* 146. 2*a*. 5–6. *pp.* 371–388, 1937.—The range of the $\alpha$-rays from a 23-year-old source of Th were determined with an ionisation chamber and a valve electrometer. By careful electrolysis, a homogeneous layer of Th of thickness 0·38 mm. on a base of thickness 0·06 mm. was obtained, both thicknesses being given in air equivalents. The results show that the extrapolated range in air produces 116,000 $\pm$ 500 ion pairs, while the maximum range gives 117,000 $\pm$ 500 ion pairs. These correspond to ranges of 2·59 cm. and 2·62 cm. at N.T.P., with an error of $\pm$ 0·01 cm. F. C. C.

**1119. Dependence of the Range of $\alpha$-Particles from Po on the Type of Source. J. Schintlmeister.** *Akad. Wiss. Wien, Ber.* 146. 2*a*. 5–6. *pp.* 389–408, 1937.—The range of the $\alpha$-particles from 5 different sources of Po was determined with an ionisation chamber and valve electrometer. The mean range was found to depend greatly upon the purity of the source and upon the angle of emission to the surface of the source. F. C. C.

**1120. Scattering of $\alpha$-Particles from Po by Heavy Nuclei and the Emission of Particles of Short Range. W. Jentschke and G. Stetter.** *Akad. Wiss. Wien, Ber.* 146. 2*a*. 5–6. *pp.* 409–420, 1937.—Using an ionisation chamber, experiments were carried out to detect the production of short range particles when $\alpha$-particles from Po are scattered by Xe and by I. The production of short range particles occurs with both elements and it is concluded that scattering accounts for the results, without involving a nuclear disintegration process. **H. Pettersson and J. Schintlmeister** (*p.* 420) contribute a note stating that they still consider their results give evidence for a difference in the behaviour with Xe and with I, indicating disintegration with the former element [see Abstract 9 (1935)]. F. C. C.

**1121. Independent Disintegration of Polonium Atoms. J. Thibaud and M. Ferber.** *Comptes Rendus*, 205. *pp.* 1383–1385, *Dec.* 27, 1937.—Application is made of a principle given earlier [see Abstract 4351 (1937)]. Two methods of registering the $\alpha$-particles from polonium are considered ; firstly, using an intense source and collection over a small solid angle, and secondly, using a weak source and collection over a com-

plete sphere. Comparison of the experimental results is made with theory. Agreement in the first case is excellent, but in the second case the experimental values exceed the theoretical figures. G. O. B.

**1122. Determination of Radium Content of Rocks by Direct α-Ray Counting. J. H. J. Poole.** *Roy. Dublin Soc., Proc.* 21. *pp.* 595–608, *Jan.*, 1938.—The Ra-content of rocks has been found by counting the number of α-particles emitted in a known time by the Rn contained in the rock. Two methods have been used for liberating the Rn from the rock specimen ; first Joly's electric furnace method, in which fusion with alkali carbonates is employed, and second Evans' direct fusion method, in which the rock powder is decomposed at a temperature of about 2000° C. in a special type of graphite boat electric vacuum furnace. The counting of the α-particles is carried out by an ionisation chamber and a Wynn-Williams type five-stage amplifier, the output of which is led either to a moving iron oscillograph or to a simple type of mechanical counter. Full experimental details are given, and the merits and drawbacks of the method discussed. Some results are quoted, and a reproduction of a typical oscillograph record shown. [See following Abstract.] AUTHOR.

***1123. Theoretical Efficiency of Cylindrical Ionisation Chambers for Estimating Radon by α-Particle Counting. J. H. J. Poole.** *Roy. Dublin Soc., Proc.* 21. *pp.* 609–614, *Jan.*, 1938.—In the method described [see preceding Abstract], the number of α-particles which were counted per min. per $10^{-12}$ C. of Rn was determined experimentally. In this paper the value of this constant is calculated mathematically on certain assumptions. The agreement between the theoretical and experimental results is satisfactory. AUTHOR.

**1124. Scattering of Fast β-Particles in Nitrogen. Part I. E. G. Stepanowa.** *Phys. Zeits. d. Sowjetunion*, 12. 5. *pp.* 550–560, 1937. *In English.*—Results obtained with an expansion chamber for the single scattering of β-particles from RaC in $N_2$ are described. Two energy ranges were used : 200 to 1100 ekV and 1500 to 3000 ekV. The observed distribution curve of scattered β-particles as a function of the scattering angle lies considerably above the theoretical curve calculated by Mott's method. The discrepancy is especially great for particles in the energy range 1500 to 3000 ekV, where the observed scattering at angles greater than 90° is 30–35 times greater than that calculated. The effective cross-sections for 200–1100 ekV are from 1·5 times to twice as great as the theoretically expected values while for 1500–3000 ekV they are 12 times as great. In order to explain the observed anomaly, nuclear forces in addition to the Coulomb field are proposed. AUTHOR.

**1125. Coefficient of Absorption of Uranium Y β-Rays. Z. V. Erchova.** *J. de Physique et le Radium*, 8. *pp.* 501–504, *Dec.*, 1937.—In determining the coefficient of absorption of the β-radiation of uranium Y it is discovered that the radiation consists of two distinct components ; one having a coefficient of $\mu/\rho = 19{\cdot}6\,\mathrm{cm^2.\,gm^{-1}}$., and the other a coefficient of 216. A description is given of the method of preparation of uranium Y from the parent salt. A Pohl electrometer and an ionisation chamber were used in the experiments along with Al and cellophane as absorbing substances, both of which gave similar results. A determination of the radioactive constant of uranium Y gave the figure $\lambda = 2{\cdot}90 \times 10^{-2}\ \mathrm{hr^{-1}}$., agreeing well with the accepted value of $2{\cdot}85 \times 10^{-2}\ \mathrm{hr^{-1}}$. G. O. B.

**1126. Continuous β-Ray Spectrum of Thorium B. R. Arnoult.** *Comptes Rendus*, 206. *pp.* 184–186, *Jan.* 17, 1938.—Measured by the

author's magnetic focusing method the $\beta$-ray spectrum of ThB → C appears to end at $H\rho = 2270$. The conclusion that the disintegration is accompanied by the emission of one electron for each atom disintegrated is confirmed, the actual ratio being 114 for 100 with a possible error of 15%. [See Abstract 147 (1938).] C. A. S.

**1127. Reflection of $\beta$-Rays. J. A. Chalmers.** *Phil. Mag.* 25. *pp.* 322–334, *Feb.*, 1938.—Calculations are carried out on the basis of classical mechanics to determine the reflection coefficient of $\beta$-rays incident at various angles upon a solid surface. The reflection coefficient for electrons incident at all angles is found to be three times the reflection coefficient for electrons which are confined to perpendicular incidence. Application to the determination of the number of $\beta$-rays per disintegration for RaE gives a value less than unity. F. C. C.

**1128. Upper Limits of Continuous $\beta$-Ray Spectra. E. E. Widdowson and F. C. Champion.** *Phys. Soc., Proc.* 50. *pp.* 185–195, *March* 1, 1938.—An objective method of treating absorption data is devised for obtaining the most reliable value for the upper limit of continuous $\beta$-ray spectra. The effect of geometrical conditions, of change of source-intensity, and of source-thickness on the absorption curve and on the apparent upper limit is discussed. Feather's empirical equation [see Abstract 3758 (1930)] connecting range and energy of $\beta$-rays is corrected in accordance with more recent determinations. The corrected equation is $R = 0{\cdot}536E - 0{\cdot}165$. The method is applied to absorption curves obtained for the $\beta$ rays emitted from $Mg^{27}$, $Si^{31}$ and $As^{76}$. The values $0{\cdot}885 \pm 0{\cdot}068$ gm./cm$^2$, $0{\cdot}571 \pm 0{\cdot}047$ gm./cm$^2$ and $1{\cdot}400 \pm 0{\cdot}024$ gm./cm$^2$ are in good agreement with the values obtained by other methods. Authors.

***1129. Efficiency of a $\gamma$-Ray Counter. G. J. Sizoo and H. Willemsen.** *Physica*, 5. *pp.* 105–110, *Feb.*, 1938. *In English.*—A method is described by which it is possible to determine the sensitivities of a $\gamma$-ray counter for the various wave-lengths of the monochromatic components of a heterogeneous $\gamma$-radiation, if the intensities and the absorption coefficients of these components are known. To apply this method the absorption in Pb of the $\gamma$-radiation of Ra was measured with a counter. Though it was not possible to calculate the sensitivities directly by the method described, the solution could be found by trial. The relation between sensitivity and wave-length obtained in this way is somewhat different from that obtained by G. v. Droste from theoretical considerations. [See Abstract 1597 (1937).] Authors.

*See also* Abstracts 909, 1266, 1275.

# RADIATION.

## ABSORPTION.

***1130. Monochromatic Filters for Spectrum Lamps. H. Naumann and J. Kaltenbach.** *Zeits. f. wiss. Phot.* 37. *pp.* 27–32, *Jan.–Feb.*, 1938.—Gives details of aniline dye filters suitable for use with the Osram metallic spectrum lamps recently produced, and briefly describes the method of measurement of their transmission. R. C. F.

## COLORIMETRY.

***1131. Luther Condition in Colour Measurement. M. Richter.** *Zeits. f. wiss. Phot.* 37. *pp.* 36–41, *Jan.–Feb.*, 1938.—Theoretically examines

the requirements of filters for colour measurement which satisfy the condition given by Luther [see Abstract 872 (1928)] as regards their transmission. Two equations are derived, these being compared graphically with the transmission curve of a filter commercially produced. R. C. F.

**1132. Space Coordinates of the Vectors for Colour Production. H. E. J. Neugebauer.** *Zeits. f. wiss. Phot.* 37. *pp.* 32–35, *Jan.–Feb.*, 1938.—Briefly discusses the three-dimensional representation of colour production, giving the derivation of the space coordinates of the necessary associated vectors. R. C. F.

## ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

*See* Abstracts 914, 915, 924, 1201.

## EMISSION.

**1133. Nature of Elementary Light Sources and Interference Phenomena. S. I. Wawilow.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 9. *pp.* 463–466, 1937. *In English.*—For Fresnel interference phenomena the intensity distribution in the interference pattern, as well as the polarisation of the fringes, should depend upon the manner in which the radiation intensity of the source is distributed along various directions in space. The problem is investigated mathematically for (1) dipole radiation, (2) quadrupole radiation, (3) *Bremsestrahlung*, (4) radiation of electrons moving in a medium with velocity in excess of the phase velocity of light. A. H.

**1134. Theory of Multipole Radiation. J. Blaton.** *Acta Physica Polonica*, 6. 3. *pp.* 256–277, 1937. *In German.*—Formulæ are given for resolving the field of a vibrating charge and current distribution into electric and magnetic multipoles. The application of these formulæ yields simple results for the Zeeman effect of multipole lines. Even the formula for the intensity of electric dipole radiation is not entirely determined by the charge distribution, but correction terms are obtained which are of importance if the wave-length of the emitted light is of the order of the Compton wave-length. R. P.

**1135. Cosmic Radiation and Activity of Meteors. J. Zirkler.** *Zeits. f. Physik*, 107. 9–10. *pp.* 653–655, 1937.—The author's observations with ThC [see Abstract 1546 (1935)] indicated phenomena of extra-terrestrial influence connected with meteor activity. Corlin's mean values of the intensity of cosmic radiation have been used and shown to be related directly to the activity of meteor showers. R. S. R.

**1136. Cosmic Radiation as an Intra-Galactic Phenomenon. H. Alfvén.** *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*B*. No. 29. [5 *pp.*], 1937. *In English.*—From considerations of the nature and intensity of cosmic rays and the fact of the absence of a sidereal time variation with the position of the Milky Way, it is concluded that cosmic radiation is an intra-galactic phenomenon. The theory requires a magnetic field in interstellar space and it is suggested that this is provided by double-star cyclon generators. F. C. C.

**1137. Cosmic-Ray Shower-Production from Carbon. A. Valkó.** *Helv. Phys. Acta*, 11. 1. *pp.* 59–86, 1938. *In German.*—Coincidence measurements with counters showed that the thickness of C for maximum shower-production is about 80 cm. It was found that the absorption coefficient of shower particles from C was constant for thicknesses of absorber (Pb) between 0 and 4 cm.; but that for shower particles from Pb

the absorption coefficient increased rapidly for thicknesses of absorber (Pb) up to 1 cm., and for greater thicknesses remains constant, the value being the same as that for the shower-particles from C. All these results are shown to be in accordance with the Bhabha-Heitler theory. D. H. F.

**1138. Cosmic-Ray Shower Photographs Underground. C. Haenny.** *Comptes Rendus*, 206, *pp.* 177–179, *Jan.* 17, 1938.—Counter-controlled cloud-chamber photographs were taken at a depth of 8·5 m. Out of 100 exposures taken with one counter above the chamber and one below it, no screen to act as a shower-source being used, 5 were found to show showers (compared with 25 per 100 found under similar conditions on the Jungfraujoch by others). A further 43 photographs, of which 13 showed showers, were taken with three counters beneath the chamber and a 5 mm. block of Pt in the middle of the chamber. The average number of tracks per shower photograph was 7·6, compared with 10 on the Jungfraujoch. The showers observed are discussed, and it is stated that they show no essential difference from those photographed at sea-level. D. H. F.

**1139. Energy Flux of Corpuscular Cosmic Radiation. C. G. Montgomery and D. D. Montgomery.** *Phys. Rev.* 53. *pp.* 193–195, *Jan.* 15, 1938.—Calculations are carried out which show that at sea-level, almost all of the energy in the cosmic-ray beam is carried by charged corpuscles. This conclusion is based on the assumption that all the energy in cosmic radiation is eventually dissipated in atomic ionisation or excitation. It is suggested that the theory be tested by cloud-chamber observations at high altitudes. F. C. C.

**1140. Heavy Particles in Cosmic Rays. P. Auger.** *Comptes Rendus*, 206. *pp.* 346–349, *Jan.* 31, 1938.—In a study of the highly penetrating constituent of cosmic radiation, use is made of three experimental chambers; two at depths corresponding to 30 and 75 m. of water respectively, and one at a depth corresponding to 12 m. of water. In addition this latter chamber is surrounded by a thickness of 6 cm. of Pb. Several Geiger counters are used to detect coincidences. The results from the first and third chambers indicate that the constituents of the radiation are particles whose mass is approximately 100 times that of the electron. G. O. B.

**1141. Nature of Cosmic Rays. I. S. Bowen, R. A. Millikan and H. V. Neher.** *Phys. Rev.* 53. *pp.* 217–223, *Feb.* 1, 1938.—The intensity of latitude-sensitive cosmic rays, such as would be measured by an electroscope placed just outside the atmosphere has been calculated. The ionisation due to incoming electrons of 10 billion eV energy in this same electroscope placed 1/20th of an atmosphere beneath the top is found to be 13 times that outside. Electrons do not become penetrating by virtue of high energies even up to 17 billion eV. Neither protons nor other penetrating particles of any sort enter the atmosphere in significant numbers from outside the atmosphere. The observed penetrating particles and all other cosmic-ray effects, latitude-sensitive and nonlatitude-sensitive, found in the lower atmosphere are practically all secondary effects–splashes from the absorption of electrons, or photons, or both taking place in the outer layers of the atmosphere. AUTHORS.

**1142. Penetration of Corpuscular Cosmic Rays in Matter. J. Clay and K. H. J. Jonker.** *Physica*, 5. *pp.* 81–89, *Feb.*, 1938. *In English.*—The number of shocks in one counter is measured, then the number of coincidences for two counters in every direction with the first in the centre, and finally the number of coincidences with 1 mm. Pb and 4 mm. Pb between the counters. From these results can be found the

number of coincidences when the influence of the walls can be neglected. The difference between the number of single shocks and the total number of coincidences gives the number of shocks produced by those photons that eject an electron from the wall. This number is found to be 27%. [See following Abstract.] AUTHORS.

**1143. Analysis of the Cosmic Radiation Complex. J. Clay.** *Physica*, 5. *pp.* 94–99, *Jan.*, 1938. *In English.*—The number of shocks in a single counter produced by photons must be about 27% [see preceding Abstract]. From the 73% corpuscular rays 67% can give a coincidence in two steel counters of 1 mm. wall, 11% have an energy below 1·4 eMV and 55% can penetrate more than 4 cm. Pb. From the measurements of the ionisation in gases at different pressures it is possible to find the ionisation due to the electrons ejected by the photons from the walls and from the gas itself. When this part is extracted from the total ionisation the ionisation by corpuscular rays traversing the chamber is found. It is impossible to find the specific ionisation by simply supposing that all the tracks have the same specific ionisation. The specific ionisation of the corpuscular rays is smaller than that of the photoelectrons. AUTHOR.

**1144. Soft Final Corpuscular Rays Produced by Cosmic Rays in the Walls of an Ionisation Chamber. J. Clay and J. de Bock.** *Physica*, 5. *pp.* 90–93, *Feb.*, 1938. *In English.*—It was found from the ionisation currents measured between two parallel grids in a steel vessel filled with argon at pressures up to 150 atm. that the ionisation is proportional to the pressure. Down to pressures of 75 atm. the ionisation produced by electrons from the copper walls was constant and proportional to the thickness. The upward ionisation was a little smaller than the downward one. The productions from layers of different materials were compared and it was found that the saturation value increases with the atomic number. [See also Abstract 1600 (1935).] AUTHORS.

**1145. Magnetic Storm and Variation of Cosmic Rays. J. Clay and E. M. Bruins.** *Physica*, 5. *pp.* 111–114, *Feb.*, 1938. *In English.*—The magnetic storm between April 24th and May 6th was accompanied by a decrease of cosmic-ray intensity at Amsterdam of maximum 5%. At $\lambda = 54°$ only corpuscles of an energy lower than $8 \cdot 10^9$ eV were influenced. In some cases but not in all of them a parallelism occurs between the variation of intensity and the variation of H. The decrease of the cosmic-ray intensity can be explained by a decrease of the normal intensity of the circular currents around the earth. AUTHORS.

***1146. Monochromators for Purposes of Irradiation. J. W. Perry.** *Phys. Soc., Proc.* 50. *pp.* 265–274, *March* 1, 1938.—The conditions for a large output of energy by monochromators are analysed and expressed in a convenient form. Description is given of a new type of monochromator for large output, which may be single or double, with glass or quartz optical work. An instrument constant is proposed as a measure of the output-capacity of monochromators. AUTHOR.

*See also* Abstracts 946, 1110, 1266.

## FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

**1147. Fluorescence and Phosphorescence Phenomena of Aragonite-Like Calcites. S. v. Gliszczynski and E. Stoicovici.** *Zeits. f. Krist.* 98. 4. *pp.* 344–350, 1937.—Calcites from Coruna in Rumania have

been examined, which show wonderful colour bands in all shades from purest white to deepest black. In previous work these calcites have been classified as aragonite, but a series of X-ray diagrams showed only a calcite and never an aragonite type of structure. The X-ray and u.v. phosphorescence and fluorescence phenomena have been studied for about 80 different specimens. The light phenomena increase for these radiations with the deepening of the daylight colour of the sample. The u.v. fluorescence is generally light violet, the u.v. phosphorescence, green or grey; the X-ray fluorescence is of either a greenish or reddish colour, and the phosphorescence is of corresponding colour. There seems to be no correlation between the nature of the materials and the light phenomena that they show. C. J. B. C.

**1148. Anomalous Anti-Stokes Fluorescence. F. Duschinsky.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 4. *pp.* 179–182, 1937. *In German.*—In a polyatomic molecule like aniline there is no difficulty in accounting for the anti-Stokes excess of energy by the thermal energies of the many degrees of freedom, but there are serious objections to the idea that the whole of the thermal energy of all the internal vibrations can be concentrated at one moment into one degree of freedom. There is, however, no need for such an idea since the emission of anti-Stokes radiation follows naturally from the quantum theory of band spectra and from a consideration of the Franck-Condon principle in dealing with the possible transitions in an electron vibration energy system. J. E.

**1149. Determination of the Efficiency of Fluorescence. H. Hellström.** *Arkiv f. Kem. Min. och Geologi, Stockholm,* 12*A*. *No.* 17. [12 *pp.*], 1937. *In German.*—Besides the direct method of finding the absorbed energy and the corresponding emitted energy there is the method of finding the mean life of the excited state which is based on Perrin's theoretical relation $\rho = T_1/T_2$ where $T_1$ is the actual mean life and $T_2$ is the maximal mean life of the excited state. An apparatus is described for carrying out the direct method, and the necessary measurements are explained. The efficiency was determined for fluorescein, eosin, rhodamine, methylene blue and aetioporphyrin. Curves were also obtained showing the variation of fluorescence intensity with concentration (plotting logs). The experimental curves agree with the theoretical relation based on the assumption that the fluorescence is proportional to the absorbed energy up to $\log c = 4{\cdot}9$ but beyond that the two diverge. J. E.

**1150. U.V. Luminescence of Rock-Salt After Irradiation by X-Rays. M. L. Katz.** *Phys. Zeits. d. Sowjetunion,* 12. 4. *pp.* 373–382, 1937. *In German.*—After irradiation with X-rays rock-salt crystals showed, under excitation by visible light, u.v. luminescence and a phosphorescence of exponential decay. The wave-length maximum was at 2350 Å. The phosphorescence of deformed crystals showed also another band at 2950 Å max. and these two bands were observed in the u.v. fluorescence of the same substance. The excitation spectrum for the u.v. fluorescence showed maxima at 4700 and 4900 λ. J. E.

*See also* Abstract 1133.

## INTERFERENCE, DIFFRACTION AND SCATTERING.

**1151. Diffraction of Light by Ripples on Liquid Surfaces. Part I. D. S. Subbaramaiya.** *Indian Acad. Sci., Proc.* 6*A*. *pp.* 333–339, *Dec.*, 1937.—Using monochromatic light, the spectra obtained by the diffraction

of light by a system of ripples travelling on a liquid surface have been photographed. The distribution of intensity in the spectra is a function of the amplitude of the ripples, the problem being similar to the one discussed by Raman and Nath [see Abstract 785 (1936)], The ratio of the intensities of the $m$th and the $n$th order is given by $Jm^2(v)/Jn^2(v)$, where $v = 2\pi(\mu-1)\ a/\lambda$, where $a$ is the amplitude of the ripples, $\mu$ the refractive index of the liquid, $\lambda$ the wave-lengths of the monochromatic light used, and $J_m$ and $J_n$ are Bessel functions of the $m$th and the $n$th order respectively. It is shown that by employing the diffraction method, a quantitative study can be made of the damping of progressive ripples on the surface by taking photographs at some points along the direction of propagation of the ripples and also of the damping of ripples due to surface contaminations, in this case the photographs being given as the film is compressed. Some calculations are also given. AUTHOR.

**1152. Zernicke's Phase Contrast Experiment. J. Picht.** *Zeits. f. Instrumentenk.* 58. *pp.* 1–12. *Jan.*, 1938.—The author's earlier theory [see Abstract 618 (1937)] of the phase difference in the image of Fraunhofer diffraction phenomena is amplified. C. B. A.

**1153. Shadow of a Straight Edge. E. T. Hanson.** *Roy. Soc., Phil. Trans.* 237*A*. *pp.* 35–65, *Feb.* 7, 1938.—When attempting to fit Macdonald's theory of perfectly absorbing bodies to the problem of diffraction by a wedge difficulties were encountered which showed it to be necessary to base the solution upon the properties of the geometric shadow. In this way it is possible to obtain, by new and distinct methods, solutions both for the point source and the incident plane wave. It has also made it possible to obtain the solution of a very interesting problem of diffraction in the presence of total reflection at the surface of separation of two media of different refractive indices. A. H.

*See also* Abstracts 913, 1163, 1170, 1175.

## PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

**1154. Photochemical Changes in Phosphorus Compounds and Fused Phosphates. J. Hoffmann.** *Akad. Wiss. Wien, Ber.* 146. 2*a*. 5–6. *pp.* 421–429, 1937.—Photochemical changes, principally of colour, occurring in phosphorus hydrides, $P_2O_5$, ortho- meta- and pyro-phosphates, and phosphate glasses when irradiated with daylight, u.v. light, $\beta$- or $\gamma$-radiation are briefly referred to, and a mechanism of the changes is discussed. J. S. G. T.

**1155. Photochemical Decomposition of Methane at Schumann Wave-Lengths. W. Groth.** *Zeits. f. phys. Chem.* 38. *Abt.B*. 5. *pp.* 366–380, 1937.—$CH_4$ at atmospheric pressure is irradiated with the resonance lines of Xe at 1470 and 1295 Å. The absorption at these wave-lengths is measured and the primary and secondary products of the resulting photochemical decomposition, and the quantum efficiencies, are determined. The primary process appears to be $CH_4 + h\nu = CH_3 + H$. C. B. A.

**1156. Photochemical Union of Hydrogen and Chlorine. Parts V–VII. H. C. Craggs, G. V. V. Squire and A. J. Allmand.** *Chem. Soc., J. pp.* 1869–1891, *Dec.*, 1937.—Explains and discusses the experimental method used in obtaining results given previously in Part IV [see Abstract 1603 (1936)], and describes results obtained in an investigation of the experimental laws governing the kinetics of the photochemical reaction between $H_2$ and $Cl_2$, using the same method. The $H_2$ pressure is approximately 0·1 mm. and the $Cl_2$ pressure varies between 0·11 and

450 mm. Variation between 1 and 0·05 is found in the values of the intensity exponent, decreasing as the $Cl_2$ pressures increase, and strongly absorbed radiation gives rise to lower values of the exponent than those obtained with weakly absorbed radiation. The rate of reaction increases up to a maximum and then decreases as the $Cl_2$ pressure is increased. Quantum yields between 0·05 and 2000 are derived from the results obtained, the values depending on conditions of experiment. Experiments on the effect of added HCl are discussed and suggestions given to explain the results obtained. Finally it is shown that the presence of small quantities of $H_2O$ did not accelerate, but rather retarded, the reaction.

R. C. F.

**1157. Sensitivity of Photographic Plates in the Region 2500–2000 Å. A Hunter and R. W. B. Pearse.** *Phys. Soc., Proc.* 50. *pp.* 256–264, *March* 1, 1938.—The effect of sensitising photographic emulsions for the wave-length region 2500 to 2000 Å by bathing them in fluorescent substances before exposure, or by decreasing their gelatin content, is examined experimentally. The characteristics of 17 different types of plates are compared by a simple method of sensitometry in which the plates are given stepped exposures to the $\gamma$ bands of NO under reproducible conditions. Direct density-comparisons made by visual estimation are then sufficient to give the information as to relative sensitivities which is most likely to be required by the practical spectroscopist. Apart from the Ilford Q2 plate, which has special characteristics that are fully discussed, it is found that a measurable record can be obtained with the least possible exposure on an ordinary plate. In this sense, therefore, the methods of sensitisation at present available do not have the effect which is generally ascribed to them. Their main use is for increasing contrast and saturation density, not threshold sensitivity. A table gives the relative exposure times needed for the different plates at various wave-lengths, and spectrograms on representative plates are reproduced.

AUTHORS.

**1158. Scheiner and DIN Degrees. G. Hansen.** *Phot. Indust.* 36. *pp.* 53–56, *Jan.* 19, 1938.—Examines the differences between the two systems of measuring photographic sensitivity—Scheiner and DIN—dealing with the equation connecting the degrees DIN with the true Scheiner degrees, the relationship existing between the true Scheiner and actual Scheiner degrees used, and the causes of the increase in Scheiner values.

R. C. F.

**1159. Sabattier Effect. A. Marriage.** *Kodak Research Lab., Comm. No.* 649. *Phot. J.* 77. *pp.* 619–625, *Nov.*, 1937.—The Sabattier reversal occurs when an exposed, developed and unfixed film is uniformly exposed to light and further developed. The effect is here investigated in a simplified form, by the crossed-wedge method, employing yellow-dyed emulsions in order to confine the first-developed image to the surface. Under these conditions, the effect can be explained simply by assuming the first-developed image to form a negative through which the residual silver halide is exposed. The presence of AgI has little effect.

L. V. C.

***1160. Ilford Screen Direction Indicator. F. J. Tritton and E. T. Wilson.** *Phot. J.* 78. *pp.* 15–18, *Jan.*, 1938.—The superposition of the dot images necessary in colour printing may easily lead to interference patterns unless carefully done. The angles between the rulings of the various negatives are well known and must be accurately adhered to, but existing methods for setting screens in most cameras appear to be rather crude.

The Ilford screen direction indicator is a small device intended to provide the necessary check on the setting of the screens and yields a permanent record of the exact setting of the screens. It consists of a series of semi-circular graded rulings on a copyboard and is printed with a series of radial lines separated by 15°. The interference pattern obtained is a series of concentric rings and these rings can be positioned on any one of the radial lines by using a rotating screen in the camera. When setting the screen for the next colour it is only necessary to rotate the screen until the interference rings are on another radial line at the desired angular displacement from the first line used. R. C. F.

***1161. Photoelectric Control of Exposure in Photographic Printing. C. Tuttle.** *Kodak Research Lab., Comm. No.* 633. *Frank. Inst., J.* 224. *pp.* 615–631, *Nov.*, 1937.—Devices are considered for determining the best exposure for a given printing paper, based upon measurements of " total negative density", *e.g.*, in each frame of a roll-film negative [see Abstract 4940 (1937)]. The devices are classified as (*a*) fixed time, variable intensity, or (*b*) fixed intensity, variable time. In class (*a*) it is preferable either to vary lamp intensity, in which case the desired logarithmic calibration is closely approximated by the use of parallel resistances (of which one is variable) in series with the lamp, or (in projection printing) to modify the illumination by the use either of optical wedges or of specially shaped diaphragms over the projection lens. Class (*b*) devices operate simultaneously with the printing exposure and terminate the latter when a fixed time-intensity integral has accrued. In both classes extreme accuracy has to be sacrificed to ruggedness and to simplicity and speed of operation. A selection of representative patent abstracts is appended to the paper. L. V. C.

**1162. Coating-Thickness and Picture-Definition.** *Phot. Indust.* 35. *pp.* 1339–1341, *Dec.* 15, *and pp.* 1363–1365, *Dec.* 29, 1937.—Ignoring internal refraction and light-scatter, estimates are made of the degree of unsharpness of the photographic image due to the finite thickness of the emulsion layer. The analysis is given for single-layered and for three-layered materials (as used in colour-photography) and allowance is made for lens-aperture variations. L. V. C.

**1163. New Experiments on Infra-Red Photography. M. Czerny and P. Mollet.** *Zeits. f. Physik*, 108. 1–2. *pp.* 85–100, 1937.—An extension of previous work [see Abstract 2158 (1929)]. Infra-red radiation (*e.g.*, a spectrum) is imaged, through a quartz or rock-salt window, upon a thin absorbing layer deposited on one surface of a $0{\cdot}1\ \mu$ celluloid membrane, *in vacuo*. The other surface of the membrane carries a thin uniform film of paraffin oil showing, in the absence of incident radiation, uniform interference colours when illuminated and viewed normally through a second window. Wherever radiation falls upon the membrane it is converted to heat and evaporation of the paraffin occurs, producing a change in the interference colour, which may be inspected visually or photographed in the ordinary way. The preparation of the membrane, the application of the absorbing layer—vacuum-deposited bismuth (" bismuth black "), lampblack, or Al—and the purification and application of the paraffin are described and examples given of absorption spectra extending from 1–10$\mu$. For $\lambda < 1{\cdot}3\mu$, Agfa " 1050 " infra-red plates are faster photographically than the system described, but the position is rapidly reversed as $\lambda$ increases. The sensitivity is compared with advantage with that of a radiomicrometer system ; exposures up to 2–4

min. may be employed, but at present this is the longest permissible time owing to spontaneous changes in the oil-film. L. V. C.

**1164. Stereoscopic Calculations. B. Wright.** *Phot. J.* 78. *pp.* 19–23, *Jan.*, 1938.—Comments on the theoretical considerations and practical methods previous discussed by C. W. Wilman [see Abstracts 4665 (1936) and 4490 (1937)]. The points dealt with are the determination of the limits of depth and the stop-number necessary, taking and viewing conditions, perspective, lens separation, relief, depth of field, and relief and intaglio. Finally, there is a letter from **C. W. Wilman,** *pp.* 23 and 35, in which he replies to the author's comments. R. C. F.

*See also* Abstracts 962, 1225, 1277.

## PHOTOMETRY.

***1165. Intensity Curves of Light Pulses of Short Duration. J. D. Kelley.** *J.O.S.A.* 28. *pp.* 27–29, *Jan.*, 1938.—Describes an instrument for studying the form of the intensity curve of a light pulse such as that given by a photographic shutter, a photo-flash lamp, etc. The light to be studied falls on a ground glass screen and is made to control the vertical deflection of a kathode-ray beam in a tube having a long-persistence screen. A timing device causes the line on the screen to be broken up into a dotted line with a regular time interval between the dots. Typical records are reproduced. J. W. T. W.

*See also* Abstracts 1079, 1175.

## POLARISATION.

**1166. Optical Rotatory Power of *l*-Menthol in Heavy Methyl Alcohol. E. Ogawa.** *Chem. Soc., Japan, Bull.* 12. *pp.* 545–546, *Dec.*, 1937. *In English.*—It is concluded that the difference of specific rotatory power in pure $CH_3OH$ and $CH_3OD$ is at most $0{\cdot}10°$ and the isotopic effect in the hydroxyl bond has little influence upon the field of the asymmetric C atom. AUTHOR.

*See also* Abstracts 912, 1005.

## REFLECTION, REFRACTION AND DISPERSION.

***1167. Optical Paradox. M. Herzberger.** *Kodak Research Lab., Comm. No.* 651. *J.O.S.A.* 28. *pp.* 23–26, *Jan.*, 1938.—Colour correction of lenses has again become of importance owing to the development of colour photography, and an investigation is made of the variation of focal length with wave-length. Suppose there is an optical system corrected for two, but not for three, colours then the question arises as to whether it is possible to add a system (lens) so that the entire system is corrected for three colours. It is found that it is necessary to add a system whose focal length for the third order is equal to the colour-corrected focal length of the first system, and if this second system be placed at the focal point of the first then a system is obtained corrected for three colours and having the same focal length as the first. The paradox consists of the fact that although the supplementary lens is independent of the colour correction of the first lens for the third colour yet it corrects for the third colour. This fact is of considerable importance for the colour correction of optical systems. A. H.

***1168. U.V. Dispersion Measurements. V. Holbro.** *Helv. Phys. Acta*, 10. 6. *pp.* 431–454, 1937. *In German.*—A photographic arrangement

is described embodying a hollow prism and spectrometer. An accuracy of $\pm$ 0·00025 is claimed for refractive index measurements and of $\pm$ 0·00002 for dispersion. The dispersions of thiophene, furane and pyrrol have been measured from 5000 Å to the limit of absorption, and dispersion formulæ of the Sellmeier type fitted. Measurements were also made on water and acetic acid and the results compared with those of other observers. F. S.

**1169. Optical Constants of Very Thin Metal Films. K. Försterling.** *Ann. d. Physik*, 30. 8. *pp.* 745–751, *Dec.*, 1937.—The theory is developed for a method of measuring the optical constants of very thin metal films such as can be deposited on a glass surface. C. B. A.

**1170. Classical Optics. E. Buchwald.** *Die Physik*, 6. 1. *pp.* 15–31, 1938.—A review and bibliography of recent experimental work in optics under the headings : refractive indices, scattering and Kerr effect, interference and diffraction, double refraction, and optics of metals. C. B. A.

**1171. Expansion of Glass with Tempering and Annealing. E. Rencker.** *Comptes Rendus*, 205. *pp.* 980–981, *Nov.* 22, 1937.—Beads of rapidly cooled boric anhydride were placed in a dilatometer provided with capillary tube and filled up with Hg. The dilatometer could then be placed in a thermostat or oven and maintained at a definite temperature. At about 260° the change of volume was complete in a day, but change continued for 15 days at 150°. Between 207° and 250° the phenomenon shows hysteresis, but not below this temperature range. [See following Abstract.] F. S.

**1172. Tempering and Annealing of Boric Anhydride Glass. E. Rencker.** *Comptes Rendus*, 205. *pp.* 1396–1398, *Dec.* 27, 1937.—In continuation of previous work [see preceding Abstract] it is shown that the volume-temperature curve consists of two straight lines showing a point of transformation as in the case of other glasses. The properties are modified due to heating above this temperature, there being a residual change of volume. F. S.

**1173. Boundary of Softening Range for Binary System $Na_2B_4O_7$-$B_2O_3$. A. Leontjewa.** *Acta Physicochimica*, 7. 6. *pp.* 937–941, 1937. *In English.*—Glasses and like materials which have not a definite melting point undergo rapid changes in their physical properties in the softening range between temperatures $T_g$ and $T_f$, where $T_g$ denotes the end of the solid phase and $T_f$ the beginning of the liquid phase. The derivatives of the physical properties with respect to temperature have a point of inflection within this range at a temperature $T_w$. Values of $T_w$ have been determined for the system $Na_2B_4O_7$-$B_2O_3$ by observing the beginning of elastic oscillations due to torque set up in a nichrome rod immersed in the cooling sample. A sharp maximum value of $T_w$ is found for the binary salt $Na_2O \cdot 3\ B_2O_3$. The present method gives values of $T_w$ in good agreement with those obtained from viscosity measurements. R. W. P.

**1174. Optics and the Glass Industry. E. D. Tillyer.** *J.O.S.A.* 28. *pp.* 1–4, *Jan.*, 1938.—A general article setting out the desirable properties of glass and some recent achievements. F. S.

***1175. Physical-Optical Instruments and Materials. F. Simeon.** *Phys. Soc., Reports*, 4. *pp.* 283–294, 1938.—Progress review.

## SPECTROSCOPY.

**1176. Spectrographic Determination of Niobium and Tantalum. R. Breckpot and J. Creffier.** *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 290–295, *Dec.* 31, 1937.—The intensities of lines due to Nb and Ta in the arc

spectrum given by mixtures of $Nb_2O_5$ and $Ta_2O_5$ in various proportions are found. The effect of Ti on the determination of Nb and Ta by this method is examined. A. J. M.

**1177. Spectrographic Investigation of Ternary Lead Base Alloys. R. Breckpot, J. Creffier and O. Perlinghi.** *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 295–305, *Dec.* 31, 1937.—The variation of intensity of lines due to Pb, Sn and Sb in ternary alloys of these metals with the proportions of metals present is examined. A. J. M.

**1178. Effects of Polarity in the Electric Arc. R. Breckpot and C. Weyn.** *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 306–317, *Dec.* 31, 1937.—The variation of emission intensity in the arc with poles of different materials is examined. The arcs investigated had (1) electrodes of Pb-Sn (3% Sn), (2) a positive electrode of Pb-Sn and a negative graphite electrode, (3) a negative electrode of Sb-Pb (3% Sb) and a positive graphite electrode, and (4) a positive electrode of Pb-Sb and a negative graphite electrode. The effect of Sb on (1) and (2), and of Sn on (3) and (4) is investigated. A. J. M.

**1179. Quantitative Spectrum Analysis of Highly Alloyed Iron. G. Limmer.** *Zeits. f. wiss. Phot.* 37. *pp.* 41–50, *Jan.–Feb.*, 1938.—Describes the method, due to Scheibe and Schöntag, for the analysis of a highly alloyed material, giving the derivation of the standard curves which are extremely useful when the method is used industrially. Standard curves for steel alloyed with varying percentages of Co, Cr, Mo, Ni, V and W are illustrated, and from a comparison of 22 values, obtained using the method described, with the chemical analysis value a maximum error of under 5% is obtained. R. C. F.

**1180. Quantitative Analysis, with Respect to the Component Structural Groups, of the Infra-Red (1 to 2 $\mu$) Molal Absorptive Indices of 55 Hydrocarbons. F. W. Rose, Jr.** *Bureau of Standards, J. of Research*, 20. *pp.* 129–157, *Feb.*, 1938.—Data from previous studies on the infra-red absorption spectra between 1·2 and 1·8 $\mu$ (5400 to 8900 $cm^{-1}$.) for 54 hydro-carbons have been analysed mathematically. The total molal absorptive index, K, at any wave-length, is shown to follow, within the limits necessary to define the number of groups, the formula $K = n_a\alpha + n_b\beta$ for the normal paraffin hydrocarbons, and the formula $K = n_a\alpha' + n_b\beta + n_c\gamma + n_d\delta$ for other classes of hydrocarbons, where $n_a$, $n_b$, $n_c$, $n_d$ are the number of $-CH_3$, $>CH_2$, $\geqslant CH$, and $>CH$ (aromatic) groups and $\alpha$ (or $\alpha'$), $\beta$, $\gamma$, $\delta$, are the values respectively, of the absorptive index for the respective unit group. The second equation is demonstrated to hold for branched-chain paraffins, cycloparaffins (naphthenes) and aromatic hydrocarbons, including 10 of high molecular weight ($C_{24}$ to $C_{32}$). The accuracy of the method as well as restrictions on its application are given. Possible extensions in order to distinguish between paraffins and cycloparaffins are indicated. Its use is demonstrated by an example of the identification of an unknown isomeric nonane. AUTHOR.

**1181. Spectroscopic Methods of Chemical Analysis. W. R. S. Garton.** *Phys. Soc., Reports*, 4. *pp.* 295–302, 1938.—Progress review.

**1182. Interference Measurements in the First Spectra of Neon, Argon and Krypton between 4812 and 3319 Å. C. J. Humphreys.** *Bureau of Standards, J. of Research*, 20. *pp.* 17–37, *Jan.*, 1938.—Wave-length measurements were made using Fabry-Perot etalons with aluminised quartz plates and quartz spectrographs. Measurements were relative to the adopted international standards of KrI. All but 3 of 30 possible

$1s$-$3p$ lines of NeI are measured. 17 lines of A I have been similarly measured. Measurements of KrI comprise 30 lines shorter than 4274 Å, the limit of previous work. F. S.

**1183. HgI Spectrum. K. Murakawa.** *Zeits. f. Physik*, 108. 3–4. *pp.* 168–170, 1938.—A new series is found in the HgI spectrum corresponding to the transition from the term $md^{3,1}\mathrm{D}$ to a new term $5d^96s^26p^3\mathrm{D}_3 = 11064{\cdot}9$. L. A. W.

**1184. Seventh Spectrum of Chlorine (Cl VII). L. W. Phillips.** *Phys. Rev.* 53. *pp.* 248–249, *Feb.* 1, 1938.—Twenty-two lines have been identified in Cl VII, locating 18 energy levels. From the series $3d - nf$, it is possible to obtain absolute term values for all levels involved. The ionisation potential of Cl VII is found to be 113·73 V. Authors.

**1185. Properties of the Water Vapour Spectrum and their Relations to Atmospheric Radiation. W. M. Elsasser.** *Monthly Weather Rev.* 65. *pp.* 323–326, *Sept.*, 1937.—The physical consequences of the water vapour spectrum consisting of a large number of narrow lines is here investigated. Measurements, as well as the quantum theory of the water vapour molecule, prove that the spectrum consists of a large number of narrow lines. A formula giving the intensity distribution in a spectral line is discussed and from it the absorption coefficient and the half width of the line are derived. The coefficient is seen to be proportional to the pressure and inversely proportional to the square root of the absolute temperature. A number of other minor effects on the value of the coefficient are also enumerated, the principal arising from (1) the gaps of partial transparency, (2) the change in the total line intensities due to change in concentration of the corresponding molecular states. All effects mentioned tend to decrease the absorption coefficient compared with previous values. The application of the results is briefly referred to. A. E. M. G.

**1186. Spectrum of Doubly Ionised Mercury, Hg III. M. W. Johns.** *Canad. J. of Research*, 15. *Sect. A. pp.* 193–201, *Dec.*, 1937.—The spectrum of Hg, excited in an electrodeless discharge, has been measured from 400 to 11000 Å. From these data the analysis of Hg III has been extended to include 77 new terms of the configurations $5d^86s^2$, $5d^86s6p$, $5d^97s$, $5d^98s$, $5d^97p$, $5d^96d$, $5d^97d$, $5d^95f$, and seven unidentified even terms. Isotope shifts have been observed in 11 lines and confirm the classifications of these lines. Author.

**1187. Complex Atomic Spectra. E. W. Foster.** *Phys. Soc., Reports*, 4. *pp.* 319–323, 1938.—Progress Review.

**1188. Isotope Displacement in Tungsten Lines. M. Kiuti, H. Hasunuma and T. Kawada.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 1019–1022, *Nov.*, 1937. *In English.*—Hyperfine structures of several W I lines excited in a water-cooled Schüler hollow kathode tube are investigated both with a Fabry-Perot etalon and a Lummer plate. As previously found by Grace and More [see Abstract 1172 (1934)] many W I lines exhibit triplet hyperfine structure which can be ascribed to isotope displacements between the lines of $W^{182}$, $W^{184}$ and $W^{186}$. In contradiction to Grace and More it is deduced that the deepest energy levels of the $^5\mathrm{D}$ terms and other terms investigated belong to the lightest isotope; the fact that observation of intensities of the three components leads at first sight to the opposite conclusion is due to the presence of overlapping magnetically separated components of $W^{183}$. J. E. K.

**1189. First Spark Spectrum of Indium, In II. F. Paschen and J. S. Campbell.** *Ann. d. Physik*, 31. 1. *pp.* 29–75, *Jan.*, 1938.—The hyperfine structure of the lines in the spectrum of In II have been investigated and the spectral terms are recorded and discussed. W. R. A.

**1190. Infra-Red Spectra and Modes of Vibration of Benzene Derivatives. Part I. Monosubstituted Derivatives. J. Lecomte.** *J. de Physique et le Radium*, 8. *pp.* 489–497, *Dec.*, 1937.—The absorption spectra of a number of monosubstituted benzene compounds is given [see Abstract 2624 (1937)]. The possible modes of vibration of benzene and mono- and disubstituted compounds are given and identified with the observed frequencies. H. G. C.

**1191. Interpretation of the TiO Infra-Red Bands. P. P. Dobronravin.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 8. *pp.* 399–403, 1937. *In English.*—Infra-red TiO bands lying between 8000 and 12000 Å are analysed, some of them being allocated to the system of near infra-red bands whilst the majority of the remainder are attributed to a new system having the same ground level ($^3\Pi$) as the green-blue and near infra-red bands. Eighteen of the observed heads fit the formula : $\nu =$

$$11334{\cdot}1 - 269{\cdot}9 + [924{\cdot}70(v'+\tfrac{1}{2}) - 5{\cdot}46(v'+\tfrac{1}{2})^2] - [1021{\cdot}07(v''+\tfrac{1}{2}) - 5{\cdot}03(v''+\tfrac{1}{2})^2] \quad 194{\cdot}3$$

and the transition is considered to be $^3\Sigma \rightarrow {}^3\Pi$. The term scheme for TiO is thus analogous to that for ZrO. A. H.

***1192. Absorption of $CO_2$ in the Region of the Band $4{\cdot}3\mu$ between 300° and 1000° Abs. C. Tingwaldt.** *Phys. Zeits.* 39. *pp.* 1–6, *Jan.* 1, 1938.—An apparatus is described with which the temperature dependence of spectral absorption of pure $CO_2$ and $CO_2$-$N_2$ mixtures for the band $4{\cdot}3\mu$ is measured between 300° and 1000° K. By application of Kirchhoff's law the emissive power of the whole band is determined. The data permit a test of calculations made by Schack for the transmission of heat by radiation from flames and lead to considerable differences. On the other hand the comparison becomes satisfactory when the law given by Schack for the dependence of emission on layer thickness and concentration is applied to the observations. J. E. K.

**1193. Water Molecules in Active Solutions. G. Bosschieter, J. Errera and R. Gaspart.** *Physica*, 5. *pp.* 115–120, *Feb.*, 1938. *In French.*—The authors have studied the infra-red band at $3\mu$, corresponding to the O–H vibration, of a solution of water in acetone, pyridine and a mixture of dioxane and pyridine in continuation of previous investigations [see Abstract 5341 (1937)]. These solvents are active in the sense that they give rise to strong intermolecular interaction between the water molecules and the solvent. The centres of interaction are the O and N atoms respectively. A solution of water in acetone of 1% shows a double band at 3500 $cm^{-1}$. which corresponds to the monomolecule of the water in acetone, not to the free molecule in vapour or inert solvents. With growing concentration of the solution, the two bands become one and are shifted to 3400 $cm^{-1}$. A solution of water in pyridine of only 1% produces a single broad band at 3450 $cm^{-1}$. which scarcely shifts with growing concentration. A solution of water in a mixture of dioxane and pyridine shows both the double band of the solution in solvents with O atoms and the displaced band of the solution in pyridine at the frequencies given for the single

solvents. It is concluded that the interaction between O and H is different from that between N and H. L. K.

**1194. Infra-Red Spectrum of Water in an Inert Solvent. L. B. Borst, A. M. Buswell and W. H. Rodebush.** *J. Chem. Phys.* 6. *pp.* 61–64, *Feb.*, 1938.—The infra-red absorption spectrum of $H_2O$, HDO and $D_2O$ in dilute solution in $CCl_4$ and $CS_2$ has been investigated with a grating of high resolving power, in the region $2{\cdot}6$–$3{\cdot}8\mu$. Several bands have been identified as $\nu_3$ bands and the hitherto unobserved $\nu_1$ band for $H_2O$ is believed to have been found. The frequencies observed are compared with the same frequencies in the vapour and a displacement of frequency which is proportional to the frequency itself is observed in solution. A fine structure is observed in the case of $H_2O$ which may be ascribed to rotation unless some other explanation is found. The spectrum in $CS_2$ appears to be identical with that in $CCl_4$. Authors.

**1195. $4{\cdot}3\mu$ Fundamental Band in $CO_2$ Spectrum. D. M. Cameron and H. H. Nielsen.** *Phys. Rev.* 53. *pp.* 246–247, *Feb.* 1, 1938.—The fundamental absorption band due to the oscillation $\nu_3$ in the $CO_2$ molecule has been remeasured and almost completely resolved into its rotational fine structure. The lines are found to fit the formula $\nu = 2350{\cdot}1 + 0{\cdot}780N - 0{\cdot}0031N^2$. The convergence factor $-0{\cdot}0031$ seems to fit the present data a little better than the value $-0{\cdot}0035$ given by Martin and Barker, and is in agreement with the theoretically determined value given by Adel and Dennison. Authors.

**1196. Infra-Red Spectra of Organic Molecules. L. Kellner.** *Phys. Soc., Reports*, 4. *pp.* 323–331, 1938.—Progress review.

**1197. Structure and Absorption Spectra of Colouring Matters. Isomeric Forms of Fluorescein. P. Ramart-Lucas.** *Comptes Rendus*, 205. *pp.* 1409–1411, *Dec.* 27, 1937.—Measurements of the absorption spectra of esters of fluorescein in various solvents show that solutions of fluorescein contain a coloured, fluorescent, quinonoid form, and a colourless, non-fluorescent, lactoid form in equilibrium, the relative proportions depending on the solvent. [See also Abstract 212 (1938).] C. B. A.

**1198. Absorption Spectra of Chromium Complexes Containing $D_2O$ and $ND_3$. B. Duhm.** *Zeits. f. phys. Chem.* 38. *Abt. B.* 5. *pp.* 359–365, 1937.—The effect of the inclusion of D on the absorption spectra of a series of complex Cr salts is investigated. The displacements of the lines which are observed are attributed to the weaker field of the heavy isotope. C. B. A.

**1199. Absorption of Copper Sulphate. B. Duhm.** *Zeits. f. Physik*, 107. 9–10. *pp.* 589–594, 1937.—The absorption of $CuSO_4$ crystals with both $H_2O$ and $D_2O$ as water of crystallisation has been carried out in the range 190 to 1800 m$\mu$. The introduction of $D_2O$ is found to reduce the number and intensity of bands due to the $Cu^{++}$ ion. F. S.

**1200. Predissociation of Sulphur. E. Olsson.** *Zeits. f. Physik*, 108. 1–2. *pp.* 40–44, 1937.—The $\lambda 2799$ ($v' = 10$, $v'' = 0$) band of $S_2$ is observed in absorption with large dispersion and found to exhibit distinct broadening of the rotation lines. The predissociation limit must accordingly be assumed to lie at $\lambda 2829$, as obtained also by emission spectrum observations, instead of at $\lambda 2799$ as previously indicated from absorption measurements. The large difference between the line widths of the bands $\lambda 2799$ and $\lambda 2769$ indicates that this is a case of slow setting in of predissociation. Observations reported by Lochte-Holtgreven [see Abstract 241

(1937)] of the effect of pressure in the predissociating region are not confirmed. J. E. K.

**1201. Effect on Magnetic Field on the Absorption of $Se_2$. S. Rouppert.** *Acta Physica Polonica*, 6. 3. *pp.* 228–234, 1937. *In French.*—All the bands studied are increased in intensity but less than those of $S_2$. The predissociation bands are strengthened. The effect on the continuous absorption superposed on the bands was not obtained. H. G. C.

**1202. Analogy of the Electron Terms of Oxygen-Like Molecules. E. Olsson.** *Arkiv f. Mat. Astron. och. Fysik, Stockholm*, 25*B*. *No.* 30. [5 *pp.*], 1937. *In German.*—Recent investigations by Badger, van Dijk and Lameris and the author have revealed the non-existence of previously conjectured analogies between the electron terms of $O_2$, $S_2$, $Se_2$ and $Te_2$ molecules. In this paper it is pointed out that some analogies do, however, exist and that many differences may be rationally explained. As far as the ground state is concerned analogous $^1\Sigma_g^+$ terms are known in $O_2$ and $Se_2$ and analogous $^3\Sigma_g^-$ terms in $O_2$ and $S_2$. On account of the strong absorption of the $^1\Sigma_g^+$ term in $Se_2$ it may not be concluded as hitherto that the lowest term of $Se_2$ and $Te_2$ is a $^3\Sigma_g^-$ term. Experimentally little is known with certainty about $Te_2$ terms, the data of Przeborski being insufficiently exact. Analogy breaks down apparently in the case of excited states; the $^3\Sigma_u^-$ terms of $S_2$ and $O_2$ are not analogous and no $O_2$ term analogous to the excited $^1\Sigma_u^+$ term of $Se_2$ is known. J. E. K.

**1203. Vibrational Analysis of U.V. Bands of $Li_2$, $Na_2$ and $K_2$. H. Yoshinaga.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 1073–1083, *Dec.*, 1937. *In English.*—More than 100 band heads were found in the 6 u.v. band systems of $Na_2$ already known. The molecular constants of these band systems, together with one band system of $Na_2$ and five band systems of $K_2$ which were newly found by the author, were calculated in their vibrational analysis. It was possible to determine the dissociation products, the dissociation energy and the symbol of the upper state of all u.v. band systems of $Li_2$, $Na_2$ and $K_2$ molecules, in comparing the corresponding band systems with one another according to the following facts: (i) The intensity distribution and the molecular constants of the corresponding band systems of these three molecules are similar to one another. (ii) The dissociation energy D calculated by Birge-Sponer's method is greater than the true value $D_0$. So there exists the next relation: $\nu_{00} + D' - D_0'' >$ excitation energy of dissociation products $> \nu_{00} + D' - D''$. (iii) All the upper states of these band systems are singlet. Author.

**1204. Emission Spectrum of $CCl_4$. R. K. Asundi and S. M. Karim.** *Indian Acad. Sci., Proc.* 6*A*. *pp.* 328–332, *Dec.*, 1937.—An uncondensed discharge is passed through flowing $CCl_4$ vapour and continuous emission bands are observed running down into the u.v., in addition to a group of strong heads round $\lambda 2780$ and weaker heads on either side. The latter bands appear to be due to a diatomic molecule and can be arranged in a $(v', v'')$ scheme. CCl is suggested as the emitter and the bands resemble the $\beta$-bands ($^2\Sigma \rightarrow {}^2\Pi$) of the iso-electronic molecule SiF. A. H.

**1205. U.V. Absorption of $CS_2$. O. Amiot and H. Marsac.** *J. de Physique et le Radium*, 8. *pp.* 498–500, *Dec.*, 1937.—Using a hydrogen lamp of 12 kW the absorption of $CS_2$ in dilute solution in hexane has been measured at 3200 Å. Six bands were photographed. Measurement of the index of refraction and the coefficient of absorption suggested the

existence of five bands. It is in the region of the sixth band (3000 Å) that the absorption refractive index curve departs from the theoretical.

H. G. C.

**1206. Reversible Polymerisation as Origin of a New Type of Absorption Band of Dyestuffs. G. Scheibe.** *Kolloid Zeits.* 82. *pp.* 1–14, *Jan.*, 1938.—In aqueous solutions of dyes, the $p$-electrons localised in conjugated and aromatic groups link the organic residues of the ions into various types of polymer, the solution being maintained by the water molecules associated with the ions. In the case of paracyanol, each degree of polymerisation is shown to have a characteristic absorption band. The higher polymers of some isocyanin dyes have a remarkably narrow band which shows resonance fluorescence. These polymers contain at least 150 molecules and take up much solvent, so that high viscosities result. It is shown that the positive ions are mostly responsible, and that definite equilibria exist between single and multiple molecules. Polymerisation occurs even at low concentrations in layers adsorbed on solid surfaces. The mechanism of absorption and fluorescence in these cases is discussed. C. B. A.

**1207. New Bands Ending on the $1s\sigma\,2p\sigma\,{}^1\Sigma_u$ State of $H_2$. O. W. Richardson.** *Roy. Soc., Proc.* 164*A*. *pp.* 316–345, *Feb.* 4, 1938.—This paper describes two new band systems which go down to $1s\sigma\,2p\sigma\,{}^1\Sigma_u$, the state on which the strongest hitherto known systems in the visible end. The systems extend from the yellow to the photographic infra-red limit (11750 Å) and probably beyond. The upper states are both ${}^1\Sigma_g$ states. They are very close to one another and appear to be perturbing each other as well as the state $1s\sigma\,2s\sigma\,{}^1\Sigma_g$, which is in the same neighbourhood. Their rotational structure resembles closely that of the "abnormal" ${}^1\Sigma_g$ states $3\,{}^1$K, ${}^1$L, ${}^1$M and ${}^1$N. Reasons are given which make it impossible to regard either of the two new states as states with only one electron excited. Two alternative methods of classifying the two new states and the seven other abnormal states which have transitions to $1s\sigma\,2p\sigma\,{}^1\Sigma_u$ and uniting them into a consistent scheme as states with both electrons excited are put forward and their merits discussed. Author.

**1208. Emission Band Spectrum of Chlorine ($Cl_2^+$). Part II. A. Elliott and W. H. B. Cameron.** *Roy. Soc., Proc.* 164*A*. *pp.* 531–546, *Feb.* 18, 1938.—The emission bands of $Cl_2$ have been photographed under high dispersion, and the wave numbers of many of the band lines have been measured. Vibrational and rotational analyses have been made for several bands, and it is shown that these bands belong to a doublet system, possibly ${}^2\Pi - {}^2\Pi$, and that the carriers of the spectrum are ionised $Cl_2$ molecules. No alternation of intensity is observed, showing that the $\Delta$-type doubling is unresolved. Values for the chief molecular constants of $({}^{35}Cl_2)^+$ are given. Many of the bands observed do not fit into the doublet system, and it seems likely that a second system, of similar structure to the one analysed, has its origin situated near the first one. The energy of dissociation of the lower state of the doublet bands, as determined by the method of Birge and Sponer, is considerably greater than that calculated for the normal state of $Cl_2^+$ from molecular and atomic ionisation potentials and from the heat of dissociation of the normal state of neutral $Cl_2$. [For Part I see Abstract 1231 (1937).] Authors.

**1209. Spectrum of Lutecium Monoxide. W. W. Watson and W. F. Meggers.** *Bureau of Standards, J. of Research*, 20. *pp.* 125–128, *Feb.*, 1938.—A vibrational quantum analysis is given for the most con-

spicuous band system of the LuO spectrum. The wave numbers of band heads in this system are represented by the equation: $\nu = 21471{\cdot}8 + 791{\cdot}60\ (v' + \frac{1}{2}) - 3{\cdot}12\ (v' + \frac{1}{2})^2 - 841{\cdot}66\ (v'' + \frac{1}{2}) + 4{\cdot}07\ (v'' + \frac{1}{2})^2 - 2{\cdot}07\ v'v''$. The unexpected singlet character of the spectrum and the value of the vibrational frequency are discussed. AUTHORS.

**1210. Ultra-Violet Absorption in Simple Hydrocarbons. Part IV. Unsaturated Cyclic Hydrocarbons in the Schumann Region. E. P. Carr and H. Stücklen.** *J. Chem. Phys.* 6. *pp.* 55–61, *Feb.*, 1938.—The absorption spectra of cyclohexene, cyclopentene, 1–3 cyclohexadiene and benzene have been examined in vapour phase in the region 2300–1600 Å. The electronic excitation responsible for the first group of bands in this region is practically independent of the cyclic structure of the molecule since the wave number of the first band agrees closely with that obtained for olefins having the same arrangement of H-atoms around the double bond. Characteristic vibrational frequencies and different electronic levels have been identified. AUTHORS.

**1211. Universal Constant of Band Spectra. Attribution of Band Lines to other Causes than the Rotation of the Molecule. H. Deslandres.** *Comptes Rendus*, 205. *pp.* 1337–1340, *Dec.* 27, 1937.—The formula $\upsilon = q^d l\ s'r'$ where $^d l$ is a universal constant (1062·5), $q$ is an integer, $r'$ is a small integer and $s'$ is the number of electrons which are excited, has been applied to 150 molecules. Band lines are attributed to the excitation of the electrons of one atom by a ring of electrons of a neighbouring atom instead of the rotation of the molecule. **Erratum,** *ibid.* 206. *p.* 220, *Jan.* 17, 1938. H. G. C.

**1212. Assignment of Vibrational Frequencies to Particular Bonds with Reference to Methylacetylene and Ethane. F. T. Wall.** *Am. Chem. Soc., J.* 60. *pp.* 71–73, *Jan.*, 1938.—The fractions of the total potential energy contributed by the various bonds of methylacetylene and ethane were calculated for each of the non-degenerate frequencies of the molecules. These fractions are taken as a measure of the extent to which a given mode of vibration can be assigned to a particular bond type. It is found that the so-called " C-C " single bond frequencies in particular are not pure C-C vibrations. Some generalisations are indicated which show when molecules can be treated successfully by approximate methods. AUTHOR.

***1213. Intensity of the Continuous Spectrum of Hydrogen. N. D. Smith.** *J.O.S.A.* 28. *pp.* 40–45, *Feb.*, 1938.—In order to construct a most intense source of the continuous spectrum of $H_2$, the most favourable conditions were systematically investigated. The intensity varied linearly with the current density except for very high current densities where it varied less rapidly. The pressure for a maximum of intensity was found to be a function of the current density and practically varied from 1 to 2 mm. A study of the relation of the intensity to length, surface, and cross-section of the capillary was made. On the basis of these results a powerful source of the continuum was constructed. This source was compared with the positive crater of the carbon arc and found to be superior in intensity below 2925 Å. AUTHOR.

**1214. Fluorescence Spectra of p-p-Dioxy-dicinnamyl-Methane Solutions. K. Morkowska.** *Acta Physica Polonica*, 6. 3. *pp.* 235–243, 1937. *In French.*—The fluorescence and absorption spectra of the dye are observed under a variety of conditions. Variation of the wave-length of the exciting radiation within the region of the absorption bands has no

effect on the fluorescence. The fluorescence decreases on continued illumination in benzene solution due to a photochemical effect. The wave-lengths of all the spectra increase with decreasing temperature in most solutions. Displacement of the bands to longer wave-lengths is proportional to the dielectric constant of the solvent. H. G. C.

**1215. Emission Spectra of ZnS and Alkaline-Earth Sulphide Phosphors. S. Rothschild.** *Zeits. f. Physik*, 108. 1–2. *pp.* 24–39, 1937. —The centres of gravity of various bands appearing on the emission spectra of ZnS phosphors are determined, and found to be to a large extent independent of the mode of excitation and the conditions of preparation of the phosphors. Four bands are observed with maxima at 4600, 5230, 5870 and 4660 Å and ascribed respectively to ZnS.Ag, ZnS.Cu, ZnS.Mn and ZnS. The displacements of the centres of gravity of bands resulting from admixture of CdS are measured for a series of phosphors and various proportions of CdS ; it is found that the positions of the band maxima bear a definite relationship to the molar proportions of the component phosphors ; a similar relation has been found by Travnicek for CaS.SrS mixed phosphors. The wave-length of light excited bands of CdS, CdS.ZnS and CdS.ZnS.Ag phosphors is dependent on temperature ; in the case of mixed phosphors the dependence on temperature becomes more marked with increasing CdS content. The blue band of ZnS.Cu excited by kathode rays is ascribed to pure ZnS and the green band observed in excitation by light is ascribed to ZnS.Cu. The formation of CdS.CaS and CdS.SrS mixed phosphors is reported ; these also exhibit band displacements dependent on the proportion of CdS. J. E. K.

**1216. Fluorescence of the Rare Earths. H. Gobrecht.** *Ann. d. Physik*, 31. 2. *pp.* 181–186, *Jan.*, 1938.—An account is given of a new fluorescence of pure Ce salts and solutions which is observed at u.v. wave-lengths, and of the fluorescence of the rare earths in borax or phosphate beads. Only those rare earths which exhibit line fluorescence spectra as crystals or solutions exhibit them in the beads with the exception of Tm, which fluoresces in the beads and not in its pure salts. C. B. A.

**1217. Zeeman Effect of Hyperfine Structure Components. E. Rasmussen.** *Zeits. f. Physik*, 107. 11–12, *pp.* 741–745, 1937.—The Zeeman effect of hyperfine structure is investigated for very low fields, in which the external magnetic field is less than the average field due to the nuclear spin (absence of Paschen-Back effect). The measurements are made on the Cd I line 4678 and in a field of 500 Gauss. The results agree well with theoretical formulæ and confirm the usual interpretation of the hyperfine structure lines of Cd. R. P.

**1218. Stark Effect in Argon and Krypton. J. S. Foster and C. A. Horton.** *Roy. Soc., Phil. Trans.* 236*A*. *pp.* 473–493, *Jan.* 12, 1938. —In a field of 100 kV/cm. Stark effects have been observed for 86 normal levels in A, and for 75 levels in Kr. Thirty-four electric combination lines have been found in A and 48 in Kr. Typical sections of the energy level diagrams for Ne, A, Kr, and Xe are drawn to represent the normal levels and their Stark effects. The diagrams serve as a basis for the qualitative explanation of the main features observed. Since intercombinations between terms of high and low limit respectively are much weaker in Ne than in A, it is found that in the former gas the Stark effects for the two sets of terms are much more nearly independent. The reversal of the direction of displacement of several terms in A and Kr with increasing field is discussed. The number of Stark levels deduced from observations in the

field is never greater than the number of $m$ values allowed by the $j$ value of the term. Several lines in the arc spectra of A and Kr are identified by their Stark effects. No Stark effects were observed for the spark lines which appear on the plates. Certain corrections to the earlier work by Ryde are suggested. AUTHORS.

**1219. Raman Spectra of Cyclo-Pentane, -Pentanone, -Pentene and -Pentadiene. A. W. Reitz.** *Zeits. f. phys. Chem.* 38. *Abt.B.* 5. *pp.* 381–392, 1937.—The depolarisation ratios of the Raman-lines have been measured for the substances in the title. It is believed that the results now obtained, together with earlier ones for furane and thiophene, allow a reasonable allocation of frequencies to a plane five-membered ring model having the symmetry $C_{2v}$. If pyrrol has the same kind of structure, then there must be still two polarised lines so far unobserved between 700 and 1000 $cm^{-1}$. Alternatively the symmetry is in some way different from that of the others. [See also Abstract 727 (1938).] A. C. M.

**1220. Raman Spectra of $PCl_3$ and $BiCl_3$ in Various Solvents. A. E. Brodsky and L. W. Kortschagin.** *Acta Physicochimica*, 6. 5. *pp.* 791–796, 1937. *In German.*—The Raman spectra of $PCl_3$ dissolved in ethyl ether, $CS_2$, and in chloroform were photographed. The spectra of the solute and of the solvent were found to be additive. The intensity of the $PCl_3$ lines was found not to be proportional to the concentration in chloroform. The ratio of the intensities of the Stokes and anti-Stokes lines was in agreement with theory. The Raman spectrum of $BiCl_3$ dissolved in HCl was measured. A. C. M.

**1221. Raman Effect and Constitution of $ZnI_2$ and $CdI_2$ Solutions. M. L. Delwaulle, F. François and J. Wiemann.** *Comptes Rendus*, 206. *pp.* 186–189, *Jan.* 17, 1938.—Raman spectra are observed for solutions of $ZnI_2$ and $CdI_2$ in water and various alcohols, with and without the addition of alkali iodide. It is concluded that the undissociated $ZnI_2$ molecule is characterised by $\Delta\nu = 152$ $cm^{-1}$. and that in addition two complexes (characterised respectively by $\Delta\nu = 127$ and 108 $cm^{-1}$. approx.) are present in aqueous solution. The undissociated $CdI_2$ molecule is characterised by $\Delta\nu = 135$ $cm^{-1}$. approx. The value $\Delta\nu = 114$ $cm^{-1}$. approx., observed in the solutions of $CdI_2$ in the lower alcohols and water, is ascribed to a complex. L. A. W.

***1222. Double Monochromator for the 0·2 to 4$\mu$ Region. C. Leiss.** *Zeits. f. Physik*, 107. 11–12. *pp.* 766–768, 1937.—Instead of using two prisms, the beam is made to pass twice through the same prism, and is reflected twice from the rear face of the prism, which is convex. In between it is reflected by a small mirror which is mounted behind a slit. The emerging beam is parallel to the incident one and displaced by only about 8 mm. R. P.

***1223. Vacuum Spectroscopy. R. W. B. Pearse.** *Phys. Soc., Reports*, 4. *pp.* 311–318, 1938.—Progress review.

*See also* Abstracts 907, 976, 979, 1130, 1134, 1146, 1175, 1270.

## TRANSMISSION.

**1224. Spectral Investigation of Glucose Glass. W. M. Cohn.** *J. Chem. Phys.* 6. *pp.* 65–67, *Feb.*, 1938.—The spectral transmission of glucose glasses has been investigated over the wave-length region from 3600 to 8000 Å. Glasses of different thermal history were tested, ranging from white to dark brown in colour. The glasses show different trans-

mission values, and shifts of the transmission maximum and the absorption limit at small wave-lengths with increasing caramelisation. AUTHOR.

## VISION.

**1225. Retinal and Photographic Resolving Powers. V. Ronchi.** *N. Cimento*, 14. *pp.* 445–450, *Nov.*, 1937.—Discusses the resolving power of the eye and the effects of wave-length, contrast, brightness, duration of view, etc., on this characteristic. The similar data available on the resolving power of photographic emulsions indicates an analogy between the two phenomena. This analogy may help to throw light on the mechanism of retinal resolving power. J. W. T. W.

***1226. Ultra-Short Illumination of the Eye. B. Deriagin.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 8. *pp.* 409–410, 1937. *In English.*—A rotating mirror device is described for the investigation of the effect of single light stimuli (duration $10^{-3} \rightarrow 10^{-7}$ sec.) on the eye. An advantage of the apparatus described is that the illuminated area of the retina is fixed, and not changed by the use of the rotating mirror. The interval between successive flashes is also variable over a considerable range. A. H.

## X-RAYS.

**1227. Non-Characteristic White and Black Lines in the X-Ray Spectra Obtained by Crystal Diffraction. Y. Cauchois and H. Hulubei.** *Comptes Rendus*, 206. *pp.* 181–184, *Jan.* 17, 1938.—The presence of dark oblique lines on certain X-ray spectra has been indicated, which are related to the well-known white lines, and like them, arise in the continuous background diffused by the analysing crystal [see Abstract 3629 (1937)]. A single incident wave may undergo simultaneous selective reflection at two planes in a crystal $h$ (indices $h_1\ h_2\ h_3$) and $h'$ ($h_1'$, $h_2$, $h_3'$); the incident energy is divided between the two reflected waves and the transmitted wave. On the continuous spectra due to $h$ and $h'$ usually appears a white line. It can be shown that the wave reflected by $h$ can be again reflected by the plane $h$–$h'$ (indices $h_1$–$h_1'$ etc.), the new reflected wave being propagated in the same direction as that reflected from $h$. If the reflection from $h$ is much less intense than the reflections $h'$ and $h$–$h'$, a black line appears in the spectrum of $h$. These non-characteristic black lines have been observed in a quarter transmission, focusing spectrometer. In the L spectrum of Th the black line from (120) is very distinct ($\lambda = 771{\cdot}9_4$ x.u.), and a white line from (130), $\lambda = 770{\cdot}9_3$ x.u. A fine black line is on some plates close to Cu K$\alpha_2$ which does not correspond to any known characteristic line; it also appears with other anti-kathodes, but is absent on spectra given by crystals of other systems. A study of these new non-characteristic lines (so-called because they are characteristic not of the emission analysed but of the analysing crystal), should lead to interesting quantitative knowledge on the structure of crystals, their deformations, structure factor, indices of refractives, etc. C. J. B. C.

**1228. L-Series of Elements 32 Ge to 19 K. F. Tyrén.** *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*A*. *No.* 32. [11 *pp.*], 1937. *In German.*—A previous investigation of the L-series of elements 29 Cu to 26 Fe [see Abstract 1740 (1936)] is extended to the other elements in the range 32 Ge to 19 K. The reference lines are O VII, 21·602 Å and Cu $L_{\alpha}^{II}$, $2 \times 13{\cdot}330$ Å instead of H-like optical lines as hitherto. The

wave-length measurements for L$\beta$, L$\alpha$, L$\eta$ and L$\gamma$ are presented graphically and in tabular form. The characteristics of L-lines of elements in this range are discussed. J. E. K.

**1229. L-Spectra and Characteristic Levels of Thorium. Y. Cauchois and M. L. Allais.** *Comptes Rendus*, 206. *pp.* 344–346, *Jan.* 31, 1938.—Using either mica or quartz in their crystal analyser, the authors have made a determination of wave-lengths in both the emission and absorption L-spectra of Th. The results are given in tabular form; from these the characteristic levels of Th have been calculated. G. O. B.

***1230. Hot-Kathode Demountable X-Ray Tube and Vapour Trap. P. M. Harris.** *Rev. Sci. Instruments*, 8. *pp.* 478–480, *Dec.*, 1937.—The tube is intended for spectrographic work, and stability of operation is attained largely by using a high potential target in an earthed metal discharge chamber. The kathode assembly is conveniently made from an automobile sparking plug, and lead gaskets are used for vacuum seals. The liquid-air trap is designed to prevent mercury vapour passing into the X-ray tube, without interfering appreciably with the speed of the pump. G. E. B.

***1231. Low-Temperature X-Ray Spectrograph. A. Goetz.** *Zeits. f. techn. Physik*, 18. 12. *p.* 572, 1937. *Phys. Zeits.* 38. *p.* 998, *Dec.* 1, 1937.—Reference is made to an X-ray spectrograph in which the crystal to be examined can be cooled to any temperature between room-temperature and that of liquid He. The apparatus is used for the measurement of the variation of the intensity of X-ray reflection with temperature. J. T.

*See also* Abstracts 942, 1150.

# HEAT.

## CALORIMETRY.

***1232. Molecular Heat, Heat of Fusion and Entropy of Fluorine. E. Kanda.** *Chem. Soc. Japan, Bull.* 12. *pp.* 511–520, *Dec.*, 1937. *In English.*—The method used is that previously used for the measurement of the specific heat of organic compounds at low temperatures [see Abstract 3928 (1935)]. The apparatus is here illustrated and described. Cooling is by liquid $N_2$ or liquid or solid $H_2$, and the temperatures are measured with a Pt thermometer wound round the calorimeter. The amount of gas in the calorimeter is determined by a special pipette method and the heating energy is obtained by measuring the current in the heating coil and the p.d. across its ends. Radiation and conduction corrections are described, and the method of correcting for the heat loss and obtaining the true temperature rise are given. Preliminary tests of the apparatus using $O_2$ gave values in good agreement with those of other workers. The characteristic temperature was calculated from Debye's law and the entropy was obtained from the equation $s = \int_0^T (Cp/T)dT$, and the real gas correction applied. E. H. D.

**1233. Molecular Heat of Methane in Solid Mixtures of Methane and Krypton. A. Eucken and H. Veith.** *Zeits. f. phys. Chem.* 38. *Abt.B.* 5. *pp.* 393–394, 1937.—A correction to previous work [see Abstract 273 (1937)] shows that the experimental data for the molecular heat of $CH_4$ in solid mixtures of $CH_4$ and Kr agree well with the theoretical "intercombination" curve. A. J. M.

*See also* Abstract 1243.

## CONDUCTION.

**1234. Heat Capacity of Diamond from 70 to 300° K. K. S. Pitzer.** *J. Chem. Phys.* 6. *pp.* 68–70, *Jan.*, 1938.—The specific heat of diamond has been measured over the temperature range 70 to 300° K. and is compared with the theoretical formula of Debye. Small but definite deviations are observed, which in both direction and order of magnitude are those to be expected when the approximations of the Debye formula are taken into consideration. The entropy of diamond at 298·1° K. is 0·585 ± 0·005 cal./deg./mol. AUTHOR.

**1235. Suggested Explanation of Properties of Liquid He II. A. Michels, A. Bijl and J. de Boer.** *Physica*, 5. *pp.* 121–124, *Feb.*, 1938. *In English.*—A possible mechanism for the heat conduction in liquid He II is indicated. In this connection the abnormal velocity of flow is also discussed. AUTHORS.

**1236. Effect of Temperature on Thermal Conductivity and Accommodation Coefficient of Hydrogen. H. Spencer-Gregory and E. H. Dock.** *Phil. Mag.* 25. *pp.* 129–147, *Jan.*, 1938.—Investigation was made on $H_2$ between 0° C. and − 182° C. The temperature coefficient of thermal conductivity is calculated from the definition $\gamma = 1/K_T (dK/dT)_T$ where $K_T = 2{\cdot}14 \times 10^{-6} \times T^{0.938}$, at the absolute temperatures 273·1, 203·8, and 94·6 respectively, and the results of measurements made near these three temperatures are also given. The results from definition are 0·0034, 0·0046, 0·0099; and from measurements 0·0031, 0·0049, 0·0101. The results on which the definition is based are given. Values of the thermal conductivity and the coefficient of accommodation are given in tables and represented graphically in regard to their dependence on temperature. The results for the coefficient of accommodation calculated from the temperature-drop theory are found to vary in magnitude from a value 0·48 at the temperature of liquid $O_2$ to a value 0·23 at 0° C., the rate of change at the former temperature being abnormally high.

J. J. S.

*See also* Abstracts 1243, 1364.

## CONVECTION.

**1237. Instability of Fluids Heated from Below. K. Chandra.** *Roy. Soc., Proc.* 164*A*. *pp.* 231–242, *Jan.* 21, 1938.—Smoke is used to reveal the motion of air enclosed in a shallow cell heated at the base and cooled at the top. Two types of movement are observed. In type I cellular vortices occur, the air moving downwards in the centre; in type II the air ascends at the centre, and the structure of the vortices is less clearly defined. Type I is invariably obtained for air layers of more than 10 mm. thick, and type II for layers less than 6 mm. thick. In the intermediate range the type depends on the temperature difference. Measurements are made of the critical temperature difference required to establish the motion. Jeffreys' theory [see Abstract 1467 (1928)] is found to satisfy the results for type I down to a thickness of 7 mm. The motion of type II, however, appears at lower temperature differences than are required by this theory. The effects produced when the upper surface is sheared are also described and correlated with measurements of thickness and temperature difference. R. W. P.

**1238. Transverse Bands in Layers of Air Heated from Below. D. Avsec.** *Comptes Rendus*, 206. *pp.* 40–41, *Jan.* 4, 1938.—Reference is

made to forms of thermoconvective air currents produced in a layer of moving air heated from below which were first described by Phillips and Walker [see Abstract 1880 (1932)]. Experiments with smoke injected into an air layer 2 cm. deep are now described, and diagrams are reproduced showing how it is that the air and smoke separate out into alternate transverse bands circulating in opposite directions. R. W. P.

**1239. Suggested Verification of Rayleigh's Criterion. P. Vernotte.** *Comptes Rendus*, 206. *pp.* 46–49, *Jan.* 4, 1938.—The author contends that the experimental work of Schmidt and Milverton [see Abstract 5089 (1935)] does not confirm Jeffreys' conclusion that transfer of heat in a thin layer of liquid heated from below is purely by conduction until conditions are such that Rayleigh's criterion attains the value 1709. It is considered that the pre-convective stage ends much sooner than Schmidt and Milverton suggest, in accordance with a theory proposed by the author [see Abstract 1747 (1936)]. J. S. G. T.

*See also* Abstract 1243.

## DILATATION.

***1240. Thermal Expansion of Rh and of Al and Mg Alloys. H. Ebert.** *Phys. Zeits.* 39. *pp.* 6–9, *Jan.* 1, 1938.—Modifications which have been made to apparatus in use at the Reichsanstalt for the measurement of expansion coefficients are described. Up to temperatures of about 1100° C. fused quartz is used for all auxiliary pieces, as its coefficient is low and well known. In the work now reported for Rh, where determinations up to 1500° C. are given, this is replaced by the sintered corundum, recently examined by Ebert and Tingwaldt [see Abstract 3737 (1936)], a furnace of the Nernst type again being employed. Results obtained after stabilising heat treatments are also given for five Mg and Al alloys up to about 400° C. R. W. P.

*See also* Abstracts 1171, 1245.

## FUSION AND SOLIDIFICATION.

**1241. Freezing Points of Pure Hydrocarbons of the Gasoline Boiling Range and of their Binary Mixtures. J. Smittenberg, H. Hoog and R. A. Henkes.** *Am. Chem. Soc., J.* 60. *pp.* 17–22, *Jan.*, 1938.—

*See also* Abstracts 1171, 1172, 1173, 1245.

## TEMPERATURE.

**1242. Potentiometer Method for Determining Time-Temperature Curves. C. Perrier and A. Bellanca.** *Accad. Lincei, Atti*, 26. *pp.* 245–251, *Oct.*, 1937.—A description is given of a method of obtaining the time-temperature curves in thermal observations with thermoelectric couples, by means of a potentiometer arrangement which is more accurate and sensitive than the ordinary method with a needle galvanometer. J. J. S.

**1243. Heat. R. W. Powell.** *Phys. Soc., Reports*, 4. *pp.* 76–102, 1938.—Progress review.

**1244. Refrigeration. E. Griffiths.** *Phys. Soc., Reports*, 4. *pp.* 124–133, 1938.—Progress review.

***1245. Thermal Apparatus and Measurements. Part II. H. Moser and C. Tingwaldt.** *Die Physik*, 6. 1. *pp.* 1–14, 1938.—A general review is given of the improvement in the construction of apparatus for

thermal measurements and in the accuracy of such measurements since the field was last surveyed by F. Henning [see Abstract 1641 (1934)]. The subject is discussed under the following headings :—thermal expansion, vapour pressures and freezing points, calorimetry, thermometric scales, fluid and resistance thermometers, thermoelements, production of very high temperatures, radiation pyrometry, flame temperatures and thermal radiation. H. J. H. S.

*See also* Abstract 1333 and

778B. Resistance Thermometer of Heat Resistant Semiconductors. H. Grüss.

## THERMOCHEMISTRY.

**1246. Limits of Detonation of Mixtures of Hydrocarbons and Air. M. Rivin and A. Sokolik.** *Acta Physicochimica*, 7. 6. *pp.* 825–836, 1937. *In French.*—Experiments in a 30 m. tube reveal the impossibility of producing an explosion wave spontaneously in mixtures of ethyl ether, pentane and petroleum ether with air at normal pressures and temperatures and with ignition by powerful condenser discharge. In all cases the flame is extinguished within 10 in. from the spark. In hydrocarbon-air mixtures, analagous to mixtures in a petrol engine, the explosive wave is only propagated within narrow limits of concentration near the stoichiometric mixture but a "pseudo-detonative" wave is observed within wide limits of concentration. Detonation is not obtained in hydrocarbon-air mixtures containing 4 to 5% $CO_2$ which are closely similar to actual motor mixtures ; it appears therefore that detonation in an internal combustion engine is entirely determined by the "chemical sensitisation" of the gas mixture during compression. The limits of detonation of $C_2H_4$-air mixtures are defined and the impossibility of ignition of ethane-air mixtures by an explosive wave is demonstrated. For the first time a detonating wave is produced in $CO_2$-air mixtures in the presence of insignificant quantities of $H_2$ or $C_2H_2$. J. E. K.

**1247. Ignition of $NH_3$ and $N_2$-$H_2$. N. W. Tokarew and N. I. Nekrassow.** *Acta Physicochimica*, 7. 6. *pp.* 837–848, 1937. *In German.*—The ignition ranges of $N_2$-$H_2$-$O_2$, $N_2$-$H_2$-Air and $NH_3$-$O_2$ mixtures are determined for various temperatures. The concentration limits of ignition are found to be 5% to 90% for the mixture ($3H_2 + N_2$), with $O_2$, 6% to 87% for the mixture ($3H_2 + N_2$) with air and 10% to 80% for $NH_3$-$O_2$ ; the corresponding temperatures of inset of self-ignition are 440°, 550° and 700°. A linear relation is found between the coefficients of the empirical quadratic equation connecting the minimum explosion temperature and the concentration of combustible gas. For a given concentration a linear relation also exists between the minimum pressure and the temperature of initiation of ignition of the mixtures ; the straight line plots for different concentrations intersect in a point at the self ignition temperature which corresponds to the minimum limiting pressure of spontaneous ignition. This limiting pressure and the self-ignition temperature may therefore be derived by linear extrapolation of other data. It is established that the temperature of initiation of spontaneous ignition and the limiting pressure of spontaneous ignition do not depend on the percentage of combustible gas in the mixture. J. E. K.

## THERMODYNAMICS.

**1248. Laws of Equilibrium Displacement Applied to Mixtures of Liquids. P. M. Monval.** *Comptes Rendus*, 205. *pp.* 1154–1156, *Dec.* 6, 1937.—The laws of van't Hoff—le Chatelier are supported by observations of (*a*) variation of mutual solubility with temperature, (*b*) thermal effects of mixing liquids at their critical mixing temperature, (*c*) variation of mutual solubility with pressure, (*d*) change of volume on separation of mixed liquids, as applied to the following mixtures (*a*) aniline-cyclohexane (upper critical point, 30·95° C., 45·7% aniline), (*b*) *n*-hexane-nitrobenzene (upper critical point, 20·2° C., 49% hexane), (*c*) triethylamine-water (lower critical point, 18·5° C., 48% water). Further similar studies were made on saturated solutions of $KNO_3$ and $NH_4Cl$ at their freezing-points. L. V. C.

**1249. Thermodynamic Properties of $N_2O_4$ and $NO_2$. W. F. Giauque and J. D. Kemp.** *J. Chem. Phys.* 6. *pp.* 40–52, *Jan.*, 1938.—The vapour pressures of solid and liquid $N_2O_4$ have been measured with a mercury manometer, and also the heat capacity, melting point and latent heats of fusion and vaporisation. The apparatus and methods of test have been described elsewhere, and the results are tabulated in this paper. An equation has been fitted to the results, and by applying the third law of thermodynamics to the calorimetric measurements the entropy of the gas at the boiling point has been found. The whole equilibrium between $N_2O_4$ and $NO_2$ is discussed at length and several quantities of thermodynamic interest are calculated in combination with spectroscopic data for the substances concerned. The possible structure of the $N_2O_4$ molecule, on the basis of these results is also considered. An extensive summary of the data on this equilibrium is given. E. H. D.

**1250. Thermodynamics. J. H. Awbery.** *Phys. Soc., Reports*, 4. *pp.* 103–123, 1938.—Progress review.

**1251. Structure and Thermodynamic Properties of Long-Chain Compounds. Parts I and II. A. R. Ubbelohde.** *Faraday Soc., Trans.* 34. *pp.* 282–299, *Feb.*, 1938.—In Part I the lattice energies of $C_{14}H_{30}$, $C_{15}H_{32}$, $C_{16}H_{34}$, $C_{18}H_{38}$, cetene, and dihexyl ketone have been determined from observations of the vapour pressure, from vapour pressure equations and latent heats of vaporisation, and from the specific heats and heats of transformation or fusion of various of the above compounds. The volume change of tetradecane on solidifying, and on being heated up to 140° was also used. The value for the tilted structure of paraffins is approximately $1·29 \times 10^{-13}$ erg per $CH_2$, and for the vertical structure, approximately $1·05 \times 10^{-13}$ erg per $CH_2$. It is lowered by the double bond, and increased by the dipole in hexyl ketone. In Part II the premelting of octadecane has been investigated by determining the specific heat of three different samples of the substance, below and above the setting point, and the effect of likely impurities on the melting point. Marked premelting occurs over a range of 15° below the setting point, even with samples containing less than 1% of impurities. The effect is probably due to a process occurring in the solid phase near the melting point. The results are discussed in connection with solid transitions in general. A. J. M.

*See also* Abstracts 944, 988, 989, 1080, 1232.

## VAPORISATION AND CONDENSATION.

**1252. Vapour Pressure of Liquids and Solids. J. K. Syrkin.** *Acta Physicochimica*, 7. 6. *pp.* 867–874, 1937. *In English.*—The binomial

equation $\log p = A - b/T$, in which T is the temperature, and A and $b$ are constants characteristic of a given liquid, is discussed from the standpoint of a relation between A and $b$. $\log p = \log \Pi\ (1-T_s/T)/(1-T_s/\theta)$, (where $\Pi$ is the critical pressure, $\theta$ is the critical temperature and $T_s$ is the boiling point), is found to afford pressures from the boiling point to the critical temperature accurately to within 2–3%. For most organic substances $T_s/\theta = 0{\cdot}64$, whilst for a number of inorganic compounds it is approximately $0{\cdot}6$; $\log \Pi$ is in most cases within the limits $1{\cdot}7$ to $1{\cdot}9$. The usual equation for the vapour pressure of liquids, *viz.*, $p = CT^{\gamma}e^{-\lambda/RT}$, with coefficients C and $\gamma$ independent of the nature of the liquid, is discussed, but it is found that in the neighbourhood of the boiling-point, no general formula can express the vapour pressure in a satisfactory way and it is expedient to adapt formulæ with uniform coefficients for groups of similar substances. Extending the work to solids, it is found that the calculation of vapour pressure by the formula, $\log p_s = 4{\cdot}75(1-T_s/T_m) + \sigma/4{\cdot}57\,T_m - \sigma/4{\cdot}57\,T$, where $T_m$ is the melting point, is a good approximation. H. H. Ho.

**1253. Dissociation Pressures of Deuterates of Cupric Sulphate and of Strontium Chloride. F. T. Miles and A. W. C. Menzies.** *Am. Chem. Soc., J.* 60. *pp.* 87–90, *Jan.*, 1938.—Dissociation pressures in the systems consisting of $D_2O$ vapour and $CuSO_4$, $5D_2O$ and $3D_2O$ and also $SrCl_2$, $6D_2O$ and $2D_2O$ are reported in the temperature range 25 to 50°, and compared with analogous hydrate pressures. The related heat values are deduced and compared with those of others, and attention is called to certain discrepancies of the present values from those obtained in three investigations by other workers. Authors.

*See also* Abstracts 1091, 1243, 1245.

# ACOUSTICS.

**1254. Stresses Produced in Solids by Sound Waves. A. D. Fokker.** *Physica*, 5. *pp.* 31–38, *Jan.*, 1938. *In French.*—A mathematical paper. General formulæ are obtained for the stresses produced by elastic waves in isotropic solids. For sinusoidal waves the stresses take the form of pressures. As pointed out by L. Brillouin in the case of longitudinal waves the pressures are isotropic in a plane perpendicular to the direction of propagation, and in the case of transverse waves, are isotropic in the plane of polarisation. The results are generalised for crystalline media. K. M. C.

**1255. Timbre Phenomena in the Church Organ. F. Trendelenburg.** *Zeits. f. techn. Physik*, 18. 11. *pp.* 477–480, 1937.—This paper examines, by the aid of oscillographic analysis, timbre effects found in certain stops in various church organs. J. E. B.

**1256. Organ Pipes and Edge Tones. G. B. Brown.** *Nature*, 141. *pp.* 11–13, *Jan.* 1, 1938.—The organ pipe note is not so ideally simple in production as portrayed in the text-books. It is higher in pitch than the natural note of the pipe used as a resonator, also the pitch varies with the pressure of the air supply. When the air is admitted with slowly increasing pressure, the pipe emits a succession of tones which are intimately connected with the general problem of edge tones [see Abstract 4620

(1937)]. An open flue pipe of frequency 130 and stated dimensions was examined stroboscopically by means of smoke-impregnated air, the free edge tones for a jet of the same width and wedge height being added for comparison. The pipe tone changes correspond exactly with those found by Rayleigh. The mechanism of the production of the sequence of tones is explained in the light of the author's theory. Edge tones are responsible for the initiation of the vibrations in musical wind instruments and they can adequately account for details of the complex initial phenomena. G. E. A.

**1257. Theory of the Clarinet. R. N. Ghosh.** *Acoustical Soc. of America, J.* 9. *pp.* 255–264, *Jan.*, 1938.—The author points out that the partials of the clarinet note are not accounted for by existing theory. This paper, which is entirely mathematical, gives a theory of the clarinet which is based on the assumption that the gap between the mouthpiece and the reed is never completely closed. The vibration of the reed is also studied. Better agreement with observed results is claimed. K. M. C.

***1258. Apparatus for Acoustic Research in the Supersonic Frequency Range. A. Noyes, Jr. and G. W. Pierce.** *Acoustical Soc. of America, J.* 9. *pp.* 205–211, *Jan.*, 1938.—Three instruments are described which are intended for use, primarily, in the frequency range 1 to 100 kc./sec. The first is a sonic amplifier designed on the superheterodyne principle and containing a balanced modulator for eliminating the local oscillator frequency from the intermediate circuits, and a magnetostriction filter for obtaining high selectivity. The second is a standard signal generator covering the given frequency range on a single tuning dial. It is for use in testing and calibrating, and also, with an amplifier, in energising a vibratory sound source. It provides known voltages from 0·5 $\mu$V to 1 volt at any frequency in the range mentioned. The third apparatus is a sensitive, tuned, a.c. voltmeter with either linear or logarithmic response, for measuring the voltage developed by a sound-sensitive device in response to supersonic excitation. Complete wiring diagrams are given. G. E. A.

**1259. Supersonic Absorption in Smokes. T. J. Laidler and E. G. Richardson.** *Acoustical Soc. of America, J.* 9. *pp.* 217–223, *Jan.*, 1938. The attenuation of h.f. sound in smokes is studied by means of the Pierce acoustic interferometer. Supersonic waves radiated from a quartz crystal are reflected from a movable plane reflector back to the crystal. The reaction on the quartz is detected by a change of current in the crystal circuit. As the reflector is moved parallel to the direction of propagation of the waves a series of peaks and troughs in the current is recorded. From this, the absorption coefficient is calculated [see Abstract 3361 (1934)]. The problems of obtaining reproducible smokes and of measuring the size-distribution curve of the particles are discussed. Precautions are taken to avoid rapid coagulation of the particles under the action of supersonic waves. Absorption coefficients are obtained for smokes of magnesium powder, stearic acid and lycoperdon (puff-ball) spores. The variation of absorption coefficient with concentration and with frequency of the supersonic sound is compared with that predicted by a theory of J. T. Sewell. Experiment and theory agree that the attenuation is directly proportional to the concentration, but a considerable increase in attenuation with increasing frequency is reported which is not predicted by theory. K. M. C.

**1260. Effect of Containing Tubes on Ultrasonic Velocities in Benzene. W. H. Hulswit, Jr.** *Acoustical Soc. of America, J.* 9. *pp.* 224–226, *Jan.*, 1938.—It has been shown that radial resonance affects the measured velocity of h.f. sound in liquids [see Abstract 2512 (1932)] for frequencies below 110 kc./s. For higher frequencies the effect has been assumed negligible. The author, using two interferometers with tubes 25 and 38 mm. in dia., finds that the effect in benzene at frequencies up to 700 kc./s. is still apparent, although its magnitude is greatly reduced. Field's theory seems to give the position of the first velocity peak in the vel./freq. graph. With the higher order peaks the use of the real diameter gives poor agreement with experiment, and substitution of a smaller " effective " diameter is recommended. G. E. A.

**1261. Supersonics in Relation to Molecular Constitution. E. G. Richardson.** *Phys. Soc., Reports,* 4. *pp.* 67–75, 1938.—Progress review.

**1262. Subjective and Objective Measurements of Noise. E. Lübcke.** *Naturwiss.* 26. *pp.* 17–21, *Jan.* 14, *and pp.* 33–41, *Jan.* 21, 1938. —The objective measurement of noise is regarded as more accurate than the subjective. With apparatus of the objective type, a noise can be determined in terms of its loudness and its frequency distribution, the latter depending on the constancy of the noise. With a further development of apparatus for analysis, there will be a departure from the linear measure of sound pressure hitherto employed, and in course of time the measurement will be taken direct in db or phons. When the objective method is applied to the measurement of sharp explosive noises, it registers less than the ear hears, because of the comparatively lengthy time of adjustment to the noise. Information is still lacking on the effect of certain frequency distributions and other things on the perceived impression. So long as the information is confined to certain pure tones, the log phon scale must be retained. If the above requirements were fulfilled a loudness scale could be adopted which is a measure of the strength of the disturbance. The instances cited show that the quantitative investigation of the most varied noises is proceeding, and the number of unsolved disturbances is being reduced, with resulting amelioration of their injurious effects. G. E. A.

**1263. Whispering Gallery of St. Paul's Cathedral, London. A. E. Bate.** *Phys. Soc., Proc.* 50. *pp.* 293–297, *March* 1, 1938.—The apparent disagreement between Rayleigh's deduction and those of Raman concerning the whispering-gallery phenomenon is shown to depend on the fact that Raman used a sustained source which gave rise to interference, whereas Rayleigh dealt with a whisper projected in one direction. Further, it is shown that, whereas Rayleigh attributed the success with a whisper to the fact that it is composed of high frequencies, low frequencies are projected equally well, and that actually the success attained with a whisper is due to its low intensity, which does not give rise to audible echoes. Explanations are offered of the circumferential and radial alternations of sound mentioned by Raman and Sutherland. AUTHOR.

**1264. Sound. E. G. Richardson.** *Phys. Soc., Reports,* 4. *pp.* 53–66, 1938.—Progress review.

*See also* Abstract 1278 and

1068B. Acoustic Radiation Pressure. E. F. Ghiron.

# ELECTRICITY AND MAGNETISM.

## ALTERNATING-CURRENT NETWORKS.

**1265. Operational Representation of Discontinuous Functions. L. A. Pipes.** *Frank. Inst., J.* 225. *pp.* 53–61, *Jan.*, 1938.—Some operational equivalents for several commonly employed discontinuous functions of particular use in the theory of electrical networks are developed. The method used is the Laplace Transform point of view of Heaviside's operational calculus. The author notes the practical utility of these methods: discontinuous expressions that do not admit of Fourier expansion because of lack of periodicity may readily be handled in this manner.

J. J. S.

*See also* Abstracts 946, 1279, 1280, 1284, 1297, 1298, 1326 and 783B. R-Matrices and Equivalent Networks. Part I. R. S. Burington.

## CONDUCTION AND DISCHARGE IN GASES.

**1266. Ionisation and Conductivity in Gases at High Pressures. J. Clay.** *K. Akad. Amsterdam, Proc.* 40. 10. *pp.* 824–836, 1937.—In dealing with the determination of the intensity of an electromagnetic radiation by measurement of the ionisation it produces in a chamber filled with a gas at a high pressure, the author shows how the effect of recombination of ions in the gas and also the effect of emission of electrons from the walls of the vessel can be dealt with, so as to allow of a correct determination of the ionisation current. The total ionisation in the gas only is found to be purely proportional to the pressure, even at high pressures provided the measurements are taken with the saturation current. In making an investigation of the ionisation produced in the rare gases by $\gamma$-rays and by cosmic rays, certain anomalies were found. The increase of ionisation with change of density and atomic number is different for the two kinds of rays. For $\gamma$-rays the ionisation increases almost in proportion to the square of the atomic number, whereas for cosmic rays the increase is simply proportional to the density of the gas. [See also Abstract 5416 (1937).] G. O. B.

**1267. Sparking Potential of Mercury Vapour. F. L. Jones. and W. R. Galloway.** *Phys. Soc., Proc.* 50. *pp.* 207–212, *March* 1, 1938.—The sparking potential of Hg vapour between parallel electrodes previously degassed at about 750° C. was measured throughout a wide range of vapour densities, and the influence of the material of the kathode on the sparking potential was examined. The sparking potential was found to be almost a linear function of $\rho d$ from about 500 to 5000 V where $\rho$, $d$ are the density of the vapour and the distance between the electrodes, respectively. The minimum sparking potential was measured for a nickel kathode, a steel kathode, and when the kathode was covered with a film or Hg; and the potentials were found to be 400, 380, and 305 V respectively. AUTHORS.

**1268. Variations in Sparking Potential in Irradiated Electrodeless Discharge Tubes. R. Zouckermann.** *Comptes Rendus*, 206. *pp.* 331–333, *Jan.* 31, 1938.—When such a tube is illuminated the effect is independent of the source of light provided the light is intense. The resulting diminution in sparking potential is greater (up to a maximum of about 15%) the more intense the light. But if the light is extinguished

before the potential is measured an irregular increase occurs therein, which is apparently dependent on the previous history, but is more marked and more regular if Hg vapour at the pressure corresponding with the room-temperature is present. No effect is produced by yellow, orange or red light. It is suggested that the effect is in some way connected with photo-electric action on the walls of the tube. [See Abstracts 1206 (1931) and 5144 (1935).] C. A. S.

**1269. Field Strength in the Positive Column of Low Pressure Discharges in Gas Mixtures. H. Alterthum and A. Lompe.** *Ann. d. Physik*, 31. 1. *pp.* 1–28, *Jan.*, 1938.—Most of the observations described concern the field in the positive column of Ne-A mixtures, measured by the probe method, the discharge being maintained by a.c. with currents from 10 to 200 mA. The field strength-current characteristics show considerable variations from pure Ne to mixtures containing 0·2 to 1% A, but no simple relationship can be discovered. Under some conditions for currents below 50 mA the field strength in pure A is greater than in pure Ne. The similar behaviour of Kr with respect to A, indicates that, at small currents and high pressures an inert gas with a smaller ionisation potential gives a greater positive column field strength than one with a larger potential. The variation of field strength with pressure was investigated for Ne-A mixtures from pure Ne to pure A. The minimum value of the field strength is displaced towards lower pressures by increasing A concentrations up to 1%, but moves up again for high A concentrations. Similar observations have been made on mixtures of Ne-Na, Ne-Hg, A-Hg, the results being comparable with those for Ne-A. Oscillograph measurements of the probe potentials in the alternate half cycles of the current confirm the electrostatic values. Possible interpretations of the phenomena are briefly discussed. J. E. R.

***1270. Excitation of Gases at Very Small Gas Pressures by Electron Collision. W. v. Meyeren.** *Ann. d. Physik*, 31. 2. *pp.* 164–176, *Jan.*, 1938.—An arrangement is described by which intensive spectra of gases at very small pressures can be produced. The excitation is due to swift electrons which by a longitudinal magnetic field along the axis of the discharge tube are combined into a beam. Thus a high current density is attained. Simultaneously the electrons are twisted round to traverse spiral paths, so that although at a pressure of $1 \times 10^{-4}$ atm. yet strong ionisation and excitation take place. From the course of the characteristic lines of the discharge tube, and from the dependence of the forms of discharge on the gas pressure, the mechanism of the discharge is explained to a far-reaching extent. With lessening of the gas pressure there occurs below $1 \times 10^{-4}$ atm. a space-charge effect, which changes the spectrum of the discharge in a marked way. Intensive $CO^+$ and $CO_2$ bands appear. It is shown that after formation of an electron space-charge the electrons can reach the glass walls of the discharge tube and there the molecular gases CO and $CO_2$ are liberated by collision. J. J. S.

**1271. Anode Rays of Heavy Metals. A. Poirot and M. Auclair.** *Comptes Rendus*, 205. *pp.* 908–909, *Nov.* 15, 1937.—The rays are obtained with $PbBr_2$, the anode being at a potential of 40–45 kV and the current passing being 0·4 mA. The light emitted consists of the arc spectrum of Pb, some strong arc lines of Ca and Al from impurities in the bromide, some lines of Cu from disintegration of the kathode and some band spectra, notably $CH^+$. The light is sufficient for work on the Doppler and Stark effects. F. S.

**1272. Distribution of the Transverse Electric Field in Positive-Ray Analysis. E. Persico.** *Accad. Sci. Torino, Atti*, 73. *Disp.* 1*a*. *pp.* 161–171, *Nov.–Dec.*, 1937.—Calculations are made of the distribution of the electric field used in the analysis of positive and neutral rays. The trajectories of secondary ions are also examined theoretically. F. C. C.

***1273. Formation of Ozone in an A.C. Low Pressure Discharge Tube. M. Senkus.** *Canad. J. of Research*, 15. *Sect.B. pp.* 525–528, *Dec.*, 1937.—Passage of a glow discharge through $O_2$ at a pressure of 25 mm. of Hg and 17000 V apparently produces no $O_3$. The non-production of $O_3$ is due to deozonisation at the electrodes. A discharge tube is described that can be used for the demonstration and quantitative investigation of the formation of $O_3$ in a glow discharge. AUTHOR.

***1274. Counting Properties of Thermally Degassed Ion-Counting Tubes with Pure Hydrogen Filling. H. Egelhaaf.** *Zeits. f. Physik*, 108. 1–2. *pp.* 19–23, 1937.—Measurements with three counter tubes which before filling with pure $H_2$ are subjected to various thermal degassing treatment show that the counting property becomes steadily worse with increasing purity of electrodes and glass surfaces and may be made to vanish altogether. It is shown that the gas and vapour films present on the electrodes before degassing are essential to the functioning of the tubes as counters. J. E. K.

**1275. Short Ion-Path H.V. Tube. W. E. Stephens and C. C. Lauritsen.** *Rev. Sci. Instruments*, 9. *pp.* 51–53, *Feb.*, 1938.—A vacuum tube for the acceleration of charged particles is described. The total acceleration of the ions takes place in a distance of 18 in. although the total height of the tube is about 14 ft. It has been used at $10^6$ V peak a.c. with target currents of 5 mA of electrons and 0·2 mA of positive ions. AUTHORS.

*See also* Abstract 910 and
724B. Building-up Period in Spark Delay. R. Strigel.
725B. Statistics of Spark Delay in Air at Atmosphere Pressure. R. Strigel.
726B. Sparking and Sparking Potential Variations. W. Rogowski and A. Wallraff.

## CONDUCTION IN SOLIDS AND LIQUIDS.

**1276. Electron Theory of the Conductivity of Thin Metallic Films. K. Fuchs.** *Cambridge Phil. Soc., Proc.* 34. *pp.* 100–108, *Jan.*, 1938.—At a few atoms thickness, the conductivity of films drops below that of the bulk metal. It is assumed that the electrons in alkali metals may be regarded as free, in the sense that $E = E_0 + h^2k^2/8\pi^2m$, which assumption is confirmed by theoretical and optical evidence. Corrections are applied to the Thomson formula $\sigma/\sigma_0 = (t/2\lambda_0)\ (3/2 + \log \lambda_0 t^{-1})$, in which (*a*) the mean free path of a single electron is taken instead of the average for all electrons, (*b*) free paths starting on the surface and (*c*) statistical distribution of free paths about $\lambda_0$, are neglected. The conductivity of a film with (1) random and (2) partially elastic scattering, is investigated by a Fermi-distribution method, by which it follows for very small thicknesses that $\sigma/\sigma_0 \sim \{4(1-\epsilon)t \log (\lambda_0/t)\}/3\lambda_0$, where $\epsilon$ is the proportion of electrons scattered elastically. Appleyard and Lovell's results [see Abstract 1338 (1937)] for Cs at 64° K. are compared with curves derived from the above formula by plotting $\sigma_0/\sigma$ against $t/\lambda_0$ with $\epsilon = 0, 0{\cdot}5, 0{\cdot}9$. For $t/\lambda < 0{\cdot}01$, *i.e.*, $t < 15$ Å, there is completely diffuse scattering. The

proportion of specular reflection increases with thickness between 0·01 and 0·14 and again approaches the curve for $\epsilon = 0$ at values of 5–10. Possible vitiation of the reasoning by the fact that a single unit Cs cell is 6·05 Å thick, and by the roughening of the film due to agglomeration, is discussed. There is some indication of a " residual " resistance. D. R. H.

**1277. Electron Conduction and Photochemical Reactions in Alkali Halide Crystals. R. W. Pohl.** *Phys. Zeits.* 39. *pp.* 36–54, *Jan.* 1, 1938.—The phenomenon of electron conduction in crystals has been largely confined to the alkali halides because they may readily be prepared in sufficient size and of the requisite degree of purity ; in addition, they have well-defined chemical properties. A review is given of work on the electron conductivity and on the photochemical reactions which occur in these crystals. The subject is treated in four sections : (1) The optical properties of the alkali halides in the pure state and with a stoichiometrical excess of an alkali metal or halogen ; (2) the motion of electrons which are liberated within the crystal under the action of light ; (3) the motion of electrons which are liberated by heat and the relation between electronic and ionic conduction ; (4) photochemical reactions in the crystals. H. J. H. S.

***1278. Electronic Voltmeter with Logarithmic Scale. M. Nuovo.** *Ricerca Scientifica*, 2. *pp.* 522–530, *Nov.*, 1937.—The various types of voltmeter which have been constructed to give a logarithmic scale are reviewed. By this means slight effects can be amplified and ranges of 50 to 60 db can be considered. Some instruments use reaction to give the logarithmic scale and others the property of certain elements having potential-current characteristics following a logarithmic law. It is possible to increase the region over which the law acts from 25 to 50 db, by using pentodes of varied polarisation in parallel. A voltmeter built upon the latter lines is described, with full details as to valves, sizes of resistances, capacities and so forth. Calibration curves are given of the instrument, and show how it can be altered for use over different ranges. H. M. B.

***1279. Measurement of Current at Radio Frequencies. T. I. Jones.** *Phys. Soc., Reports*, 4. *pp.* 231–244, 1938.—Progress review.

**1280. Absolute Measurement of Resistance. L. Hartshorn and N. F. Astbury.** *Roy. Soc., Phil. Trans.* 236*A*. *pp.* 423–471, *Nov.* 18, 1937.—Precise measurements of resistance are made by the method of Campbell. The balancing of an a.c. network establishes a relation between the product of two resistances, two mutual inductances, and the frequency of the current used. The two mutual inductances are measured by reference to a standard, the value of which is calculated from its linear dimensions. The frequency is measured in terms of astronomical time, and hence the product of the two resistances is obtained in absolute units. Their ratio is then determined by simple comparisons of resistance, and therefore each value becomes known. The conditions for high accuracy are discussed in detail. It is shown that errors may arise from harmonics, stray inductances, eddy currents, and displacement currents (capacity effects), and these are minimised and allowed for in various ways including the use of filters, special arrangements of the various circuits, the use of a Wagner earth-connection, separate measurements of the impurity and other frequency corrections of the inductors, and so on. The sensitivity obtained for the various measurements was 1 part per million, and the final result was reproductible to 3 parts per million. Allowing for an uncertainty of 10 parts per million in the calculated value of inductance, the

overall accuracy of the method is estimated to be 15 parts per million. The experiments lead to the conclusion that 1 International ohm = 1·000 50 ohm (absolute). L. H.

**1281. Electrical Conductivity of Copper Oxide. L. Dubar.** *Ann. de Physique*, 9. *pp.* 5–104, *Jan.*, 1938.—Previous investigations into the electrical conductivity of $Cu_2O$ are discussed. These show the conductivity to be influenced by impurities in the crystal lattice and notably by an excess of $O_2$. The author's experiments show that the resistance at normal temperatures increases considerably when the humidity of the air is increased. The effect is reversible, and is thought to result from a change occurring at the surface of the specimen. Heating in air to 200° C. destroys this superficial conductivity. It is considered that adsorbed $O_2$ acts on the superficial conductivity in the same way that dissolved $O_2$ increases the bulk conductivity. The opposing action of water vapour is thought to be due to the fact that the work of dissociation of $Cu(OH)_2$ into positive and negative ions is greater than that for the ionic dissociation of CuO. R. W. P.

**1282. Relation of London's Equations to the Acceleration Theory of Supraconductivity. F. Bopp.** *Zeits. f. Physik*, 107. 9–10. *pp.* 623–632, 1937.—London's equations can be obtained from the assumption that the electrons move freely, without resistance, if an undetermined function that occurs is arbitrarily put equal to zero. R. P.

**1283. Magnetic Energy of Supraconductors. P. S. Epstein.** *Nat. Acad. Sci., Proc.* 23. *pp.* 604–610, *Dec.*, 1937.—v. Laue's hypothesis that a supraconductive body begins its transition into the normal state when the strongest part of the magnetic field H at its surface reaches the critical value $H = H_c$ can be regarded as firmly established by experiment and the theoretical reasons for the dependence of $H_c$ on temperature have been given by Gorter and Casimir [see Abstract 2155 (1934)] together with an attempted theoretical derivation of v. Laue's rule. This latter is considered unconvincing by the author and the present paper is an attempt to modify the theoretical derivation of v. Laue's rule to meet his objections. R. L.

**1284. Experiments at Radio Frequencies on Supraconductors. F. B. Silsbee, F. G. Brickwedde, and R. B. Scott.** *Bureau of Standards, J. of Research*, 20. *pp.* 109–123, *Feb.*, 1938. — Measurements were made in the temperature range 2·5 to 4·2° K. on wires of Sn and Ta. A tin wire in the supraconducting transition range carrying a.c. of frequency 200,000 c./sec. superposed on d.c. was found to exhibit a potential drop having a strong component of double the applied frequency. This indicates that the supraconducting state can be destroyed by a magnetic field and recreated in a time interval of less than $10^{-6}$ sec. For each substance the transition temperature from the normal resisting to the supraconducting state was found to be the same for a.c. of radio frequency as for d.c. The effective resistance of the specimens when below their transition temperatures was found to be too small to detect at radio frequencies by the calorimetric and electrical methods tried (*i.e.*, less than 4% of that above the transition temperature in the case of Sn and less than 1% in the case of Ta). AUTHORS.

**1285. Mechanism of Ionic Conduction in Solid Salts. E. Koch and C. Wagner.** *Zeits. f. phys. Chem.* 38. *Abt.B.* 5. *pp.* 295–324, 1937.—The electrical conduction by ionic migration in solid salts is caused by certain deficiency positions, such as ions in an intermediate position in the

lattice, or vacant spaces in the lattice. At sufficiently high temperatures the deficiency positions are in thermodynamic equilibrium with the crystal as a whole. Methods are developed for the determination of the concentrations and mobilities of the individual deficiency positions. Halogen salts of Ag, Pb and Cd are used in the investigation of the conductivities. F. J. B.

**1286. Ionic Conduction in Thin Layers of NaCl. J. Boros.** *Zeits. f. Physik*, 108. 3–4. *pp.* 162–167, 1938.—Measurements are made upon the electrical conductivity of NaCl layers on glass and quartz. The layers, which have thicknesses from $0{\cdot}2$ to $2{\cdot}5\mu$, are obtained by vaporisation. High specific conductivities are observed. A marked dependence upon layer thickness is found, the effect for conduction along the plane of the layer being of opposite sign from that for conduction at right angles to this plane. The dependence of conductivity upon temperature shows discontinuities. L. A. W.

**1287. Wiedemann-Franz Law in Crystals. M. Kohler.** *Ann. d. Physik*, 31. 2. *pp.* 116–120, *Jan.*, 1938.—On the assumption that there is strong degeneration of the electron distribution, pure electron conduction and $T > \theta$, it is shown that the Wiedemann-Franz law is valid for metallic crystals which are not cubical in structure. It is independent of the orientation of the crystal. Experiments on Zn, Cd and Hg confirm this result. H. J. H. S.

**1288. Electrical Behaviour of Thin Metallic Films Condensed at Low Temperatures. H. R. Mitchell.** *Phys. Rev.* 53. *pp.* 250–256, *Feb.* 1, 1938.—The change of resistance of thin films of Zn and Cd condensed at low temperature has been studied. The resistance of a Zn film decreases irreversibly with rising temperature, but it also decreases slowly at a constant temperature above the temperature of deposition. If the surface upon which the film is deposited is of a metal similar to zinc, it influences the temperature-resistance relation, but if of a metal not similar to zinc, it does not. The experiments favour the assumption that agglomeration and crystallisation are responsible for the changes in resistance. AUTHOR.

**1289. Electrical Conductivity of KCl in Methyl Alcohol-Water Mixtures. M. K. Thomas and D. C. Mandeville.** *Indian Acad. Sci., Proc.* 6*A*. *pp.* 312–315, *Dec.*, 1937.—The electrical conductivity of KCl solutions ($M/10 - M/20000$) in $CH_3OH$ ($0 - 90\%$) has been examined. The addition of $CH_3OH$ lowers the conductivity of aqueous solutions of KCl, the conductivity reaching a minimum for solutions containing 70–80% $CH_3OH$, by volume. The effect is shown by all KCl solutions except the most concentrated ($M/10$), and is more marked the more dilute is the solution. The graph of square root of concentration against conductivity in any particular mixture of $CH_3OH$ and $H_2O$ shows maxima and minima at various concentrations of potassium chloride, the positions of which vary for different alcohol concentrations. The results are discussed from the point of view of solvation of ions. A. J. M.

***1290. Electrical Instruments. G. F. Shotter.** *Journ. Sci. Instruments*, 15. *pp.* 73–76, *Feb.*, 1938.—A review of new electrical instruments shown at the Physical Society's Exhibition of 1938.

*See also* Abstracts 927, 1339, 1365, and
731B. Siemens Moisture Content Meter for Wood. P. M. Pflier.

## DIELECTRICS AND CAPACITANCE.

**1291. Polarities of Covalent Bonds. C. P. Smyth.** *Am. Chem. Soc., J.* 60. *pp.* 183–189, *Jan.*, 1938.—The dipole moments of a number of bonds have been calculated from the moments of the molecules containing them and the structures of these molecules as indicated by electron diffraction or other information. A graphical comparison of the moments of single bonds with the electro-negativities of the elements involved shows approximate consistency except for the bonds between carbon and larger atoms, which have moments apparently greatly increased by induction. The moments of double and triple bonds are commonly increased by contributions from forms containing semipolar bonds. Somewhat mixed forms of semipolar bonds affected by resonance have moments between $2{\cdot}4$ and $3{\cdot}5 \times 10^{-18}$, the values varying from compound to compound by no more than $0{\cdot}8$ because of resonance. Semipolar bonds have polarities intermediate between those of ordinary covalent bonds and those of electrovalent bonds. [See Abstract 1889 (1937).] AUTHOR.

**1292. Theory of Absorption and Dispersion in Paramagnetic Crystals under Alternating Magnetic Fields. R. de L. Kronig.** *Physica*, 5. *pp.* 65–80, *Feb.*, 1938. *In English.*—Mathematical. An extension of previous work [see Abstract 351 (1937)]. W. R. A.

**1293. Influence of Strong Electrolytes on the Dielectric Constant of Water. A. Blicher.** *J. de Physique et le Radium*, 8. *pp.* 505–511, *Dec.*, 1937.—The dielectric constants of solutions of strong electrolytes are compared with that of KCl solution of the same conductivity by a resonance method. In order to overcome the large damping and so the flattening of the resonance curve due to the conductivity of the electrolyte, a negative resistance is supplied by a valve to annul the leak resistance of the electrolyte condenser. A piezo-oscillator maintains the frequency of the circuit and the dielectric condenser is in a specially constructed vessel, surrounded by water from a thermostat. The conductivities of the electrolytes are compared by Deubner's method. A table of results shows good agreement with the theoretical values of Debye and Falkenhagen. H. M. B.

**1294. Dielectric Behaviour of Solid HBr in the Transition Interval near 89° Abs. G. Damköhler.** *Ann. d. Physik*, 31. 1. *pp.* 76–96, *Jan.*, 1938.—The dielectric behaviour of solid HBr between 81 and 95° Abs. has been investigated. Hysteresis phenomena for the dielectric constants are discussed and possible explanations are considered. W. R. A.

**1295. Breakdown of Insulating Materials. Electric Strength. L. Hartshorn.** *Phys. Soc., Reports*, 4. *pp.* 218–231, 1938.—Progress review.

**1296. Solid Friction in Dielectric Losses. A. Gemant.** *Faraday Soc., Trans.* 34. *pp.* 269–274, *Feb.*, 1938.—It is assumed that the type of solid friction, as found by Kimball, and recently by W. Jackson and the author [see Abstract 2990 (1937)], holds also for the rotation of dipoles in solid dielectrics. By applying this solid friction to the expression of a complex viscosity, recently introduced by the author into the theory of dielectrics, formulæ for the l.f. dielectric constant and loss angle are derived. These equations not only give the right order of magnitude by numerical evaluation, but they indicate that the quantities just mentioned are, in first approximation, independent of the frequency, a behaviour

which is often observed with technical insulating materials. In addition a quantitative explanation of the experimental solid friction law is given on the basis of the imperfect structure of solids. AUTHOR.

**1297. Effect of Residual Inductances in H.F. Capacitance Measurements. J. G. Miller.** *Am. Chem. Soc., J.* 60. *pp.* 42–46, *Jan.*, 1938.—Analysis is made of the effects of residual inductances in the measurement of a capacitance at high frequencies. A method is proposed for calculating the true value of the capacitance of a cell used in measuring the dielectric constant of liquids of low conductance. This method is based on parallel substitution measurements made at varying frequency and constant total capacitance. AUTHOR.

**1298. Capacitance at Ultra-High Frequencies. R. King.** *Phil. Mag.* 25. *pp.* 339–363, *Feb.*, 1938.—An approximate formula is derived from the Maxwell equations for the input admittance of a circular parallel-plate condenser as a function of frequency. A simple equivalent circuit is shown which represents well the input admittance down to centimetre waves. Restrictions on the dimensions of the plates and on the properties of the dielectric medium between them are considered, and reference is made to the measurement of dielectric constants by the condenser method. An approximate expression is derived for predetermining the input reactance of a multiple-plate condenser from its static characteristics. Computed results for a General Radio Precision condenser and for a specially designed tuning unit are compared with the corresponding experimental ones measured at several ultra-high frequencies. [See also Abstract 1822 (1936).] AUTHOR.

*See also* Abstracts 903, 1304, and
729B. Electric Breakdown of Solid and Liquid Insulators. A. v. Hippel.

## ELECTROCHEMISTRY.

**1299. E.M.F. of Copper-Cupric Salt-Platinum Cells. S. Veil.** *Comptes Rendus*, 205. *pp.* 1371–1373, *Dec.* 27, 1937.—In saturated solution the e.m.f. is about 0·60, 0·30, 0·25 V for $CuCl_2$, $Cu(NO_3)_2$ and $CuSO_4$ respectively. On dilution these e.m.f.s drop asymptotically to 0·15 V representing the value for pure water, which is also that given by organic salts, *e.g.*, acetate and formate. For chloride solutions the relation holds approximately that $E = E_{H_2O} + (E_{sat.} - E_{H_2O})\,(c)^{\frac{1}{2}}$, where $c$ is the fraction of saturation solubility. D. R. H.

**1300. Electrolytes and Electrolysis. R. W. Gurney.** *Phys. Soc., Reports*, 4. *pp.* 251–282, 1938.—Progress review.

**1301. Effect of Cobalt Salts on Anodic Behaviour of Lead in a Sulphate-Containing Electrolyte. M. Rey, H. Herbiet, and P. Coheur.** *Comptes Rendus*, 206. *pp.* 179–181, *Jan.* 17, 1938.—Co in the electrolyte increases the freedom from Pb of Zn produced electrolytically with a Pb anode. With such an anode, an electrolyte of dilute $H_2SO_4$, with or without $ZnSO_4$, the kathode separated by porous porcelain, and c.d. 3 A/dcm.$^3$, if the anode be of fresh metal, in absence of any Co the electrolyte is rapidly supersaturated with $PbSO_4$, and $PbO_2$ appears on the anode and in suspension. This occurs much more slowly if the anode had already been peroxidised. Addition of 7·5 mg./l. Co slackens the action, and 22·5 mg./l. stops all but the formation of $PbO_2$ on the anode, and this is stopped by 50 mg./l. This last is also stopped for a considerable time, the longer the steeping, if the anode is previously steeped in a solution

containing Co. The action appears to be connected with the catalytic action of Co on $PbO_2$, and on the sulphate or basic sulphate of $Pb^{IV}$.
C. A. S.

**1302. Potential of Silver-Silver Ferrocyanide Electrode at 25°. J. N. Pearce and L. D. Ough.** *Am. Chem. Soc., J.* 60. *pp.* 80–82, *Jan.*, 1938.—From a series of measurements at 25°, the potential of the electrode is found to be 0·1943 V. The activity product constant and the molal solubility in water of silver ferrocyanide, $1{\cdot}546 \times 10^{-41}$ and $2{\cdot}27 \times 10^{-9}$, respectively, are calculated. AUTHORS.

**1303. Adsorption at the Mercury Drop Electrode and Maxima of the Polarographic Current-Voltage Curves. A. Winkel and H. Siebert.** *Zeits. f. Elektrochem.* 44. *p.* 127–132, *Feb.*, 1938.—The application of the drop-weight method for the measurement of electrocapillary curves was investigated. The curves obtained in $N$ and $N/10$ solutions of electrolytes were in agreement with those obtained by static methods. In more dilute solutions a deviation was found which was considered to be due to the incompletely established equilibrium of the adsorption. The potential obtained showed that the maximum was displaced to the positive compared with the maximum obtained from the static measurements. The drop-weight method enabled the adsorption ratios on a mercury surface to be measured in electrolytes of a greater concentration than $N/100$. F. J. B.

**1304. Theory of Schiller Layers. P. Bergmann, P. Löw-Beer and H. Zocher.** *Zeits. f. phys. Chem.* 181. *Abt. A.* 4. *pp.* 301–314, 1938.—Starting from the Poisson equation and the relationship between potential and ionic concentration, the equilibrium distance is calculated to which a large number of charged thin lamellæ are pressed together by gravitational force. By means of the expression now worked out relating this distance to the electrolyte concentration, number of lamellæ and dielectric constant, the data for the the Schiller layers of tungstic acid have been examined. It was found that for small concentrations, the magnitude of the distance corresponded to the observed data. At greater electrolyte concentrations the calculated are smaller than the observed distances. The agreement is satisfactory with respect to the influence of number of lamellæ and dielectric constant. H. H. Ho.

*See also* Abstracts 921, 985.

## ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

**1305. Charge of the Electron. H. R. Robinson.** *Phys. Soc., Reports*, 4. *pp.* 212–217, 1938.—Progress review.

**1306. Interaction of Elementary Particles. Part II. H. Yukawa and S. Sakata.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 1084–1093, *Dec.*, 1937. *In English.*—A new field, introduced in a previous report [see Abstract 1837 (1935)] to account for the short range force between the neutron and proton and for the $\beta$-disintegration, led to a prediction of quanta of mass about 1/10 that of the proton which could not be produced by ordinary nuclear reactions but might be present in cosmic rays. The existence of such particles has since been widely recognised by experimental and theoretical investigators. In the present paper the quantisation of the scalar field is developed, and the interaction between the heavy particle and the new field is dealt with as that between the charged particle and the electromagnetic field in quantum electro-

dynamics. The interaction between unlike particles, the neutron and proton is derived as a second-order effect, and the interaction between like particles as a fourth-order effect is discussed. Finally, the problem of the passage of high energy heavy quanta through matter is considered and the cross-sections for typical processes are calculated. N. M. B.

**1307. Probability of Collisions of the Second Kind between Atoms and Free Electrons. V. Fabrikant.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 17. 4. *pp.* 249–250, 1937. *In English.*—The Klein-Rosseland relation is used, together with the experimental probability of collisions of the first kind, to determine the probability of collisions of the second kind between excited atoms and free electrons. The calculations for Hg are not in very good agreement with the experiments of Latyscheff and Leipunski. Explanations of the discrepancy are suggested. F. C. C.

**1308. New Method of Investigating Atomic Electron Velocities. A. L. Hughes and M. M. Mann, Jr.** *Phys. Rev.* 53. *pp.* 50–63, *Jan.* 1, 1938.—It has been shown by Jauncey that when a fast electron of energy $V_0$ is inelastically scattered by an atomic electron, which has a velocity component $u$ in a certain direction, then the scattered electron will have an energy given by $V = V_0 \cos^2\theta + u(2mV_0/e)^{1/2} \sin\theta$, where $\theta$ is the angle of scattering. It can be shown from this relation that the distribution of energy among the scattered electrons is identical with the distribution of component velocities among the atomic electrons. Since this last distribution is closely related to, and identical in shape with, the profile of the modified line in Compton X-ray scattering, therefore measurements of the energy distribution of the scattered electrons will give an experimental determination of the profile of the band, which can then be tested against theoretical results. Such measurements have been made by the author in He with electron energies of 1000 to 4000 V, at a scattering angle of 34·2°. Good agreement is obtained between theory and experiment. Values for the probability of the various component velocities of the atomic electrons are tabulated. G. O. B.

**1309. Electron Diffraction Bands. H. Boersch.** *Zeits. f. techn. Physik*, 18. 12. *pp.* 574–578, 1937. *Phys. Zeits.* 38. *pp.* 1000–1004, *Dec.* 1, 1937.—The diffraction of high-speed electrons by single crystals gives rise to Laue spots and Kikuchi lines and bands. A satisfactory explanation of the origin of the bands has not yet been given. Dark or light bands are obtained depending on the conditions of experiment. Irradiation of thin single crystals of mica gives rise to the formation of diffraction rings, the geometrical position of which may be deduced from the interesection points of the Ewald diffusion sphere of the primary beam and a lattice plane of the reciprocal lattice. The importance of this ring formation in attempting an explanation of the Kikuchi bands is discussed. H. J. H. S.

**1310. Anomalous Scattering of Fast Electrons. D. Masurenko.** *Phys. Zeits. d. Sowjetunion*, 12. 4. *pp.* 360–365, 1937. *In German.*—In considering the anomalous scattering in $N_2$ of fast $\beta$-particles ($4mc^2 < W < 7mc^2$), which was discovered by Skobelzyn and Stepanova, the author shows that an explanation would require the assumption of the existence in the nucleus of discrete states, possibly of very short life (*i.e.*, $\tau \sim 10^{-20}$ sec.), which could decompose by direct electron emission. Several consequences of such an assumption are discussed. G. O. B.

**1311. Scattering of Protons by Protons. L. R. Hafstad, N. P. Heydenburg and M. A. Tuve.** *Phys. Rev.* 53. *pp.* 239–246, *Feb.* 1, 1938.—The authors' measurements of proton-proton scattering during

1936 established the existence of large nuclear forces between protons at close distances, in addition to the usual Coulomb forces. These nuclear forces give rise to scattering in excess of the Coulomb prediction, appreciable at 700 kV and very marked at 900 kV. In the energy region between between 200 kV and 600 kV the amount of scattering to be expected on the basis of attractive nuclear forces is radically different from that to be expected on the hypothesis of repulsive nuclear forces since in the first case a decrease and in the second an increase, with respect to the classical scattering, is predicted. These measurement are now extended to include this energy region, and have obtained results which can only be explained by the assumption of a strong attractive force of short range acting in addition to the repulsive Coulomb forces between the particles. The magnitude of the nuclear force required is in approximate quantitative agreement with that deduced from previous results [see Abstract 5328 (1936)], experimental difficulties due to the low residual energies of the scattered particles, and the very small numbers of counts in some regions of voltage and angle (as low as 3% of the Coulomb prediction) preventing a high precision in these results below 600 kV. AUTHORS.

**1312. Absorption of C-Neutrons in Ag, Cd and B at Different Temperatures. A. I. Leipunsky and L. Rusinov.** *Phys. Zeits. d. Sowjetunion*, 12. 5. *pp.* 561–578, 1937. *In English.*—Absorption curves of Ag, Cd and B were measured with Ag as detector, and for B with a B-lined ionisation chamber as detector for neutrons of group C emerging from liquid $H_2$, paraffin at 20·4°, 77° and 300° K., water at 300° and from paraffin oil at 463° K. The results are in general agreement with the hypothesis that C-neutrons have chiefly thermal energies, their energy distribution however deviating, especially at low temperatures, from Maxwell's law. The results are in complete agreement with the theoretical $1/v$ law for absorption of slow neutrons in B and Ag. The deviation from Maxwell's law may be fully understood by considering the relatively high absorption limit of Cd and the increase of the mean free path for energy loss of neutrons at very low energies. AUTHORS.

**1313. Slow Neutrons. P. B. Moon.** *Phys. Soc., Reports*, 4. *pp.* 198–211, 1938.—Progress review.

**1314. Diffusion of Thermal Neutrons in Aqueous Solutions of Cadmium Nitrate. F. Knauer.** *Zeits. f. Physik*, 108. 3–4. *pp.* 153–161, 1938.—The effect of addition of a Cd salt to water upon the concentration of thermal neutrons is deduced from the diffusion equation, and the relation so found is verified experimentally by means of the artificial radioactivity of Rh. The results are used to obtain the absorption cross-section of H relative to Cd, and a value in agreement with that deduced by Amaldi and Fermi is obtained. L. A. W.

**1315. Orthogonal Systems of Electron Optics. M. Cotte.** *Comptes Rendus*, 205. *pp.* 974–976, *Nov.* 22 *and pp.* 1145–1147, *Dec.* 6, 1937.—Expressions already derived [see Abstract 4191 (1937)] are applied to the consideration of the discontinuous field. In this way it is possible to study the systems suggested by Herzog which are of importance in the spectroscopic study of different points of a source. Aberrations of the second order of orthogonal systems may be calculated by a method analogous to that used by Scherzer in symmetrical systems. Expressions are derived from which it is possible to deduce the aberrations in the region of the focus and the effect on them of a diaphragm. H. J. H. S.

*See also* Abstracts 942, 971, 1124, 1358.

## ELECTROSTATICS.

**1316. Potential Problem of a Sphere Between Infinite Conducting Planes. C. Hurst.** *Phil. Mag.* 25. *pp.* 282–290, *Feb.*, 1938.—The problem of the electrical field produced by a distribution of charge on a conducting sphere lying between two parallel earthed planes is investigated for the general case when the sphere is placed anywhere between the planes. The method used is that of combining a series of harmonic functions, each of which vanishes over the two planes, in such a way as to give the required value of the potential at the surface of the sphere. J. J. S.

**1317. Electrification of Liquid Droplets. G. Lovera and A. Pochettino.** *N. Cimento*, 14. *pp.* 393–410, *Nov.*, 1937.—When a stream of $N_2$ was blown through a solution of an organic salt, the droplets of liquid, passed between two electrodes connected to a Lindemann electrometer, were found to be charged both positively and negatively. The magnitude of the charge varied with the rate of flow of the gas and with the concentration of the solution. The form of the curves of charge against concentration is different for positive and negative charges, and has a number of points, characteristic of the salt, at which the positive and negative charges are equal. For methylene blue and quinine bisulphate there are two such points, and for uranin there is one. W. H. W.

**1318. Method of Measuring Density of Electrostatic Charges. R. Pinoir.** *Comptes Rendus*, 205. *pp.* 1369–1371, *Dec.* 27, 1937.—Since the production of frictional and contact charges is important in certain industries (*e.g.*, paper) it is necessary to evaluate them. When a charge is induced on an earthed plate by an external charge, a charge Q′ of the same sign as the latter is repelled to earth leaving an equal charge of opposite sign. If this charge is annulled by the inducing charge $n$ times per sec., a current $i_m = 2nQ'$ is produced in the conductor. The experiment is performed with a plate condenser and a sensitive galvanometer or valve circuit to measure the current generated. Among the advantages over charge measurements are: increase in available energy and no necessity for good insulation or shielding, as small charges picked up accidentally will not affect the steady current. H. M. B.

**1319. Frictional Electricity. W. H. Jones.** *Phys. Soc., Reports*, 4. *pp.* 247–250, 1938.—Progress review.

## GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

**1320. Four Transverse Magnetic Effects in Copper: New Measurements. E. H. Hall.** *Nat. Acad. Sci., Proc.* 23. *pp.* 600–603, *Dec.*, 1937.—The results of measuring the Hall effect (R), the Ettingshausen (P), the Nernst (Q), and the Righi-Leduc (S) coefficients at temperatures of 24° C, 54·5° C and 91·5° C with an attempted accuracy of 1% are given. The author discusses the application of these experimental results to his theory of electrical and thermal conduction in metals according to which when any two of the above four transverse effects are known in sign and magnitude for any metal at a given temperature, as well as certain other information the two remaining effects can be predicted. The value for Q and S thus calculated are found to be in comparatively good agreement with the experimental values and indicate correctly the sign, and the direction of the change with rise of temperature. R. L.

**1321. Galvanomagnetic Effects in Bi Alloys. N. Thompson.** *Roy. Soc., Proc.* 164*A*. *pp.* 24–47, *Jan.* 7, 1938.—Some measurements on

the Hall effect and the transverse magneto-resistance effect are described and discussed for single crystals of Bi containing known amounts of impurity up to 1% of Pb and 0·1% of Se. The author considered that the presence of small quantities of impurity might account for the large discrepancies in the published results of other workers in this field. His experimental results are used to test Jones's theory [see Abstract 3876 (1936)] and are found to be in general agreement. A hypothesis is advanced to explain the discrepancies. It is concluded that the number of free electrons per atom is of the order of $3 \times 10^{-5}$. R. L.

**1322. Resistivity Changes of Bivalent Metals, having Body-Centred Cubic Structure, in Transverse and Longitudinal Fields. M. Kohler.** *Phys. Zeits.* 39. *pp.* 9–23, *Jan.* 1, 1938.—The effect of longitudinal and transverse magnetic fields on the resistance of bivalent metals having a body-centred cubic structure is investigated theoretically on the assumption that the time of scattering is isotropic and that there is a quadratic distribution of eigenvalues. For large values of field strength, H, transverse fields give changes proportional to $H^2$, whereas longitudinal fields tend to produce an effect which reaches saturation. This behaviour of the transverse field is caused by the reciprocal compensation of an almost full and an almost empty Brillouin zone. It follows that at high field strengths and certain orientations the Hall coefficient tends to zero. With small fields both transverse and longitudinal effects are of the same order of magnitude. The change in resistance is also shown to be proportional to the resistance prior to the application of the field, a result which agrees with the experiments of Justi and Scheffers for W. R. W. P.

## MAGNETISM AND ELECTROMAGNETISM.

**1323. Theory of Ferromagnetism. L. Oertel.** *Zeits. f. Physik*, 107. 11–12. *pp.* 746–765, 1937.—The problem is treated by an approximate method due to Ludloff [see Abstract 5239 (1934)]. The method is generalised for more than one valency electron per atom, but this does not remove the discrepancy of the large difference between the ferromagnetic and the paramagnetic Curie point. The treatment by Ludloff of the problem for temperatures lower than the Curie point is criticised and corrected. The corrected results do not agree well with experiment. To improve the theory, another method is developed in which the correlations between the directions of neighbouring spins are taken into account in a crude way. The formulæ obtained in this way contain three unknown parameters and can be made to fit the experimental results. Part II gives a modified theory which takes account of the fact that some of the atoms may be ionised. It is known that this allows better agreement to be obtained for the absolute value of the saturation moment. R. P.

**1324. Magnetic Hysteresis in Single Crystals. R. Jaanus and J. Schur.** *Phys. Zeits. d. Sowjetunion*, 12. 4. *pp.* 383–388, 1937. *In German.*—Two single crystals were obtained from normal, warm-rolled transformer steel containing 3·5% Si. The magnetic measurements were made in different directions in the [100] plane. The value of the coercive force, 0·1–0·2 Oe agrees with that found by Ruder and Sixtus. The relation of coercive force to crystallographic direction is not given by Ruder's proposed formula. G. E. A.

**1325. Anisotropy of the Magnetic Energy in Single Crystals of Nickel as a Function of Temperature. N. L. Brukhatov and L. V. Kirensky.** *Phys. Zeits. d. Sowjetunion*, 12. 5. *pp.* 602–609, 1937.

*In English.*—The energy constant of the magnetic anisotropy of a single crystal of Ni as a function of temperature has been investigated by measuring the mechanical moments exerted on the sphere-shaped crystal by the magnetic field. It has been established that the anisotropy constant can be represented very accurately in a large temperature interval by the empirical interpolation formula $K = K_0 e^{-aT^2}$, where $K_0 = 40 \times 10^4$ *e*/cm³.; $a = 0{\cdot}0000341$/grad². This relation satisfies Nernst's theorem, as $(dK/dT)_{T=0} = 0$. It cannot, however, be extended to high temperatures in the region of the Curie point, since the disappearance of the anisotropy constant at the actual Curie point does not result from this relation. Nevertheless, already at about 400° K. very small values of $K$ result, which becomes practically zero. The results of the experiments have been compared with the theory of Akulov [see Abstract 3349 (1936)] which is based on an application of classical statistics. Akulov's theoretical relation represents the general character of the temperature curve $K$ correctly, deviations in detail appearing in the region of low temperatures, as was to be expected. AUTHORS.

**1326. H.F. Permeability of Thin Electrolytic Iron Layers. S. Procopiu and G. d'Albon.** *Comptes Rendus*, 205. *pp.* 1373–1375, *Dec.* 27, 1937.—A valve oscillator working at $\lambda = 210$ cm. is connected to a Lecher bifilar of Cu wires 0·18 cm. in dia., 2·2 cm. apart, in series with a fine (0·03 mm.) Cu-constantan thermocouple. By movement of a bridge, a resonance curve is deduced from galvanometer readings, and hence $\lambda$. About 2 m. is now plated with Fe of known thickness ($d$), and $\Delta\lambda$ determined; from this $\mu$ can be calculated by Laville and Mie's relation. When $d$ is large compared with $\lambda/2\pi\sqrt{\mu\sigma f}$ (where $f$ is frequency), $\Delta\lambda$ becomes constant. For $\sigma = 1/4{\cdot}2 \times 10^{-4}$, and $\mu = 100$, this value is $2{\cdot}6 \times 10^{-3}$ mm. For thinner layers some current is carried by the Cu, apparent permeability will then be below the real value, tending to zero at zero thickness, and the curve of $\Delta\lambda$ against $d$ will be parabolic. By experiment, $\Delta\lambda$ is constant at 4 cm. when $d$ exceeds $4 \times 10^{-3}$ mm. For such thin layers $\rho$ is 4 times the value for massive Fe and by Laville's formula (*Ann. de Physique*, 2. *p.* 331, 1934] $\mu = 68{\cdot}5$. Above $10^{-3}$, $d$ and $\Delta\lambda$ drop proportionately, so that the real permeability diminishes with layer thickness. At about $35 \times 10^{-6}$, $\Delta\lambda$ becomes zero, *i.e.*, $\mu = 1$. D. R. H.

**1327. Variation of Magnetisation Processes with Time in Weak Fields. H. Wittke.** *Ann. d. Physik*, 31. 2. *pp.* 97–115, *Jan.*, 1938.—It is shown that, in considering magnetisation, it is important to differentiate between the equations of state and those of reaction. The relation between these is discussed and it is shown that the two forms of distribution function which are obtained in the switching experiments [see Abstract 4407 (1935)] and in a.c. determinations are probably limiting cases of a general function which is given. [See following Abstract.] H. J. H. S.

**1328. Magnetic After-Effect. H. Wittke.** *Ann. d. Physik*, 31. 2. *pp.* 187–192, *Jan.*, 1938.—The measurements of Richter [see Abstract 4703 (1937)] can be represented by a formula given by the author [see preceding Abstract]. R. P.

**1329. Ferromagnetic Curie Points of Rare-Earth Metals. L. Néel.** *Comptes Rendus*, 206. *pp.* 49–51, *Jan.* 4, 1938.—The Curie points of Tb, Dy, Ho, Er and Tm were calculated, the diameters of the

magnetic layer being based on Slater's results [see Abstract 3938 (1930)]. Agreement with experimental results is good. C. A. S.

**1330. Air Permeance of Permanent Magnets. H. Lacoste-Tayan.** *Comptes Rendus*, 206. *pp.* 103–105, *Jan.* 10, 1938.—The magnetic flux and magnetic p.d. were measured for a number of cylindrical steel magnets containing W, Cr, Co and Ni respectively, using a flat test coil and a Chattock magnetic potentiometer. From the experimental results it is found that the air permeance is not a geometric quantity but one which depends on the nature and magnetic qualities of the steel. Although the permeance of the air is not rigorously constant for similar magnets of different quality, its geometric value enables the predetermination of the properties of a magnet with an accuracy which is sufficient in practice. G. E. A.

**1331. Initial Magnetisation. T. Kahan.** *Ann. de Physique*, 9. *pp.* 105–176, *Jan.*, 1938.—The ferromagnetic properties of Ni, Fe, Co and Ni-Al are studied in very weak fields. It is found that the Rayleigh law ($k = a + b\mathrm{H}$) holds for all the metals examined. In general there is a relation between $a$ and $b$ which depends on the mechanical and thermal treatment of the specimen as well as on its purity; in addition, magnetostriction modifies the relation in certain cases. The expression $b = ka^n$ found by several workers is shown to be valid for particular types of specimen only. Forrer has given a relation between $n$ and the Curie temperature, $\theta$, *viz.*, $n = 1400/\theta^{1\cdot7}$, and this is verified experimentally in the case of Co. In other cases the value of $n$ depends so much on the treatment received by the specimen that the general validity of this expression remains in doubt. H. J. H. S.

**1332. Magnetic Examination of Metallic Solutions of Na in $NH_3$. E. Huster and E. Vogt.** *Zeits. f. techn. Physik*, 18. 12. *pp.* 578–581, 1937. *Phys. Zeits.* 38. *pp.* 1004–1006, *Dec.* 1, 1937.—Concentrated solutions of the alkali and alkaline earth metals in liquid $NH_3$ have a metallic lustre which, on dilution, changes to deep blue. At the same time the conduction changes from metallic to electrolytic, but the transition is a gradual one. Magnetically, a transition occurs from a weak paramagnetism to a strongly "normal" paramagnetism which in the limit reaches an amount approximately equal to that of 1 Bohr magneton per atom. It is suggested that a solution of small Na content may be conceived as a dilute metal. For moderate concentrations, the observed diamagnetism is attributed to the presence of $Na_2$ molecules. H. J. H. S.

**1333. Adiabatic Demagnetisation of Cæsium Titanium Alum. J. H. van Vleck.** *J. Chem. Phys.* 6. *pp.* 81–86, *Feb.*, 1938.—Ti salts should behave more simply than most materials under magnetic cooling, since the ground level of the paramagnetic ion is here inherently doubly degenerate and so unaffected by crystalline fields. De Haas and Wiersma show that as long as the magnetic moment remains constant during adiabatic demagnetisation, the temperature is a linear function of a field strength, a most valuable fact since it permits the establishment of a thermodynamic temperature scale. The present paper computes when deviation of the moment from constancy should commence because of the perturbing effect of second-order terms (the first non-vanishing order) in the dipole-dipole coupling energy. The calculated moment does not remain constant to as low field strengths as reported experimentally. The discrepancy cannot be ascribed to a counter-balancing effect of exchange coupling but may be due to the neglect of third and higher order dipole

terms. Because of these large dipole perturbations, the status of the experimental temperature scale in Ti alum becomes rather uncertain. The present stage of the theory may be tested more accurately by using much lower initial fields than in the existing Leiden experiments. AUTHOR.

**1334. Diamagnetic and Paramagnetic Anisotropy of Crystals. K. Lonsdale.** *Phys. Soc., Reports*, 4. *pp.* 368–389, 1938.—Progress review.

**1335. Simplification of Maxwell's Equations in Conformity with the Flux-Cutting Principle. C. V. Drysdale.** *Nature*, 141. *pp.* 254–256, *Feb.* 5, 1938.—Faraday's rotating disc experiment and the later experiments of Blondel, Cramp and Norgrove, and H. A. Wilson all indicate that magnetoelectric induction is caused by the cutting of a magnetic field rather than by its rate of change; and Rowland's experiments with rotating electrostatically-charged discs similarly indicate that a magnetic force is induced by the cutting of an electrostatic field. The fundamental Maxwellian equations are based on the change of flux principle, but it is here shown that a simple transformation of these equations brings them into harmony with the flux-cutting principle and reduces them to four simple algebraic or vector equations which enable radiation problems to be treated with great simplicity and easy grasp of the physical processes involved. Application of these equations to the propagation of electromagnetic waves in isotropic and crystalline dielectrics and in semiconducting and moving media show that they lead to the same results as the Maxwellian equations. [See Abstract 2400 (1936).] AUTHOR.

***1336. Primary Standard of Mutual Inductance of the National Physical Laboratory. N. F. Astbury.** *Phil. Mag.* 25. *pp.* 290–317, *Feb.*, 1938.—The experience gained in recent years in the construction of standards of mutual inductance showed that it would be possible to obtain increased accuracy with the Campbell primary standard of mutual inductance by rewinding the secondary coil, so as to have a lower resistance, and to have a cross-section more nearly square. A new secondary coil possessing these features has been constructed. It has also been provided with auxiliary windings by means of which the mutual inductance may be varied continuously, without loss of accuracy, over a small range. This is achieved by having two additional windings, from one of which an integral number of turns may be selected, the other being in parallel with a small potentiometer, the potential circuit of which is put in series with the main secondary circuit. An interesting mechanical feature is that the adjusting and fixing screws for the new coil have been made from a synthetic resin. The metrology of the standard is briefly described, and a new series of simplified formulae for the computation of inductance and its derivatives is given, together with a formula giving explicitly the errors introduced by a displacement of the secondary coil. The use of the standard is then discussed, and the importance of capacities to earth is pointed out. A simple method of eliminating the effect of these capacities at low frequencies is given. It is concluded that the unit of inductance is now usable with an accuracy approaching 1 part in $10^6$. AUTHOR.

**1337. Adiabatic Magnetostriction of Liquid Oxygen. M. Wolfke.** *Acta Physica Polonica*, 6. 3. *pp.* 278–286, 1937. *In German.*—The adiabatic magnetostriction, *i.e.*, the change of volume upon the adiabatic application of a magnetic field, is observed for liquid $O_2$ at the boiling point. R. P.

**1338. Modulus of Elasticity of Ferromagnetic Substances in Dependence on the Temperature and on the Magnetic Field. O. Engler.** *Ann. d. Physik*, 31. 2. *pp.* 145–163, *Jan.*, 1938.—A method of determining the modulus of elasticity (E.M.) of ferromagnetic substances in dependence on the temperature and on the magnetic field. The experimental test rods are excited to longitudinal vibrations by the self-excitation method. (1) For Ni the change of the E.M. shows a maximum of the $\Delta E$ effect, *i.e.*, the change of the E.M. in dependence on the magnetic field, at about 125° C. On the basis of Kersten's theoretical relations a discussion of the results of measurement is given, which for Ni at higher temperatures show agreement with the theoretical formulæ. With the results of Nakamura there is quantitative agreement. (2) The $\Delta E$ effect for Fe shows no singularities in the region of temperature examined. (3) Four Fe-Ni alloys were investigated : (*a*) For Fe-Ni 93% there exists at 125° C. still a pronounced flat maximum of the $\Delta E$ effect. (*b*) Fe-Ni 78·5 shows only a small change of the E.M. in the magnetic field. At room-temperature there was found for the $\Delta E$ effect in the hard condition about 0·4%, after annealing about 1·4%. (*c*) With Fe-Ni 50 the $\Delta E$ effect at room-temperature attains its greatest value of about 7·3%. (*d*) With Fe-Ni 42 the temperature coefficient of the E.M. changes its sign at the critical point. (4) The course of the E.M. in Co in dependence on the temperature shows a temperature hysteresis in the region of the allotropic transformation which is also noticeable in the intensity of magnetisation and the initial susceptibility. J. J. S.

***1339. Ballistic Galvanometers in Closed Circuits. J. Gilbert.** *Helv. Phys. Acta*, 11. 1. *pp.* 87–106, 1938. *In French.*—The formulæ describing the behaviour of a ballistic galvanometer are simplified by the introduction of a parameter $\xi$ proportional to the logarithmic decrement. Two cases are considered, (*a*) when the total resistance, R, of the circuit containing the galvanometer is variable and (*b*) when the field, H, of the galvanometer magnet is variable, and the concept of critical values of R and H, such that R (crit.) $= \xi R$ and $H^2$ (crit.) $= H^2/\xi$, is introduced. The behaviour of the instrument as a meter of charge and of flux is discussed, limiting values of $\xi$ being deduced for the two cases. The application of the results to actual construction shows that the theoretical predictions of sensitivity are substantiated by actual performance. N. F. A.

*See also* Abstract 1292, and
742B. Precise Measurements of Electromagnetic Fields. H. G. Smith.
757B. Bridge Connections with Semiconducting Resistances. E. Weise.
782B. Maxwell-Lagrange Equations and their Application to the Theory of Models and the Theory of the Free Electron. G. Jochmans and F. Descans.
791B. Magnetic Properties of Ni-Cu-Fe Alloys.
792B. Magnetic Anisotropy in Sheet Steel. W. E. Ingerson and F. J. Beck, jr.
793B. Calculation and Testing of Electromagnet with Constant Pull over a large Travel. C. A. Traenkle.
797B. Design of Mutual Inductances. H. H. Wicht.

## MEDICAL RADIOLOGY AND ELECTROLOGY.

**1340. Electrical Oscillations and Biological Materials. W. H. Ward.** *Phys. Soc., Reports*, 4. *pp.* 244–247, 1938.—Progress review.

**1341. Skin Reactions Caused by 1000 kV and 200 kV Radiations. R. S. Stone.** *Radiology*, 30. *pp.* 88–93, *Jan.*, 1938.—Discusses the relative therapeutic value of 1000 kV and 200 kV X-rays. It is shown that whilst there is a 25% increase in the intensity as measured in air at 1000 kV,

the actual increase of dose as measured on the skin is negligible and that, as measured by a thimble ionisation chamber the absorption at a depth in many respects is not greater at 1000 kV than at 200 kV. The limiting factor is not skin reaction but reaction of the mucosa at a depth as to whether 1000 or 200 kV apparatus should be used and the real value of the higher voltage is in respect to treatment of very stout patients, or the use of very small fields of irradiation. It is suggested that progress in radiation therapy lies probably in the study of factors other than voltage variation. B. J. L.

***1342. Four-Gramme Radium Unit. H. T. Flint and C. W. Wilson.** *Brit. J. of Radiology*, 11. *pp.* 112–121, *Feb.*, 1938.—An account is given of the various physical factors of the new four-gramme radium unit at Westminster Hospital Annexe. The radiation fields available for treatment are described, and it is shown that the protection afforded is adequate, and better than that in the case of the previous 2 gm. unit. AUTHORS.

***1343. Rectangular Nozzle for Use in Radium Beam Therapy. W. H. Rann.** *Brit. J. of Radiology*, 11. *pp.* 122–128, *Feb.*, 1938.—The $\gamma$-ray field from a 5-gm. radium unit with a rectangular applicator is described, together with a method of evaluating the radiation dose delivered to patients. The ratio of elektron metal and celluloid ionisation currents is determined experimentally and is found constant up to a distance of 10 cm. along the axis of the $\gamma$-ray beam in water. AUTHOR.

**1344. Units and Precautions in Radiology. E. P. Vanoni.** *Ricerca Scientifica*, 2. *pp.* 498–508, *Nov.*, 1937.—This is the report of the International Commission on units of measurement and safety precautions in radiology. They deal with the following topics :—units of measurement for X-rays and $\gamma$-rays, doses and specifications for treatment for X-rays and $\gamma$-rays, and instruments. As regards precautions the following topics are discussed :—hours of work, requirements for diagnostic and therapeutic work, precautions against electric and photographic dangers, and the dangers caused by the use of radium. G. G.

*See also* Abstract
850B. Triograph. H. E. Hollmann.

## OSCILLATIONS AND WAVES.

**1345. Voltage-Distribution and Electron Transit Time in Space-Charge-Limited Planar Diode. R. Cockburn.** *Phys. Soc., Proc.* 50. *pp.* 298–310, *March* 1, 1938.—In an earlier paper [see Abstract 4018 (1935)] the solutions for the voltage-distribution and electron transit time in a planar diode were restricted to the case of temperature limitation. In this present paper the case of space-charge limitation is dealt with. Langmuir's equations for the voltage-distribution are put into a more convenient form, and expressions are then derived to show the dependence on emission current of the interelectrode current, the kathode field, and the electron transit time for any normal values of emission velocities. [See also Abstract 926 (1937).] AUTHOR.

**1346. Sudden Short-Wave Fading, and its Relation to Magnetic and Solar Phenomena. R. Jouaust, R. Bureau and L. Éblé.** *Comptes Rendus*, 205. *pp.* 1427–1428, *Dec.* 27, 1937.—A continuation of previous observations [see Abstract 933 (1937)]. During 1936–37 (1st Oct.), 41 fadings out of 78 were simultaneous with small magnetic disturbances. Lack of correlation was shown in some instances to be due

to the distance of the (magnetic) observatory from the daylight portion of the wave trajectory and consequently from the solar action on the ionosphere. Correlation with chromosphere eruptions is established for about the same number of fadings. It may be deduced that chromosphere eruptions provoke the sudden fadings and also small local magnetic disturbances, different in character from magnetic storms. R. M.

**1347. Propagation of Electromagnetic Waves in an Ionised Atmosphere. L. G. H. Huxley.** *Phil. Mag.* 25. *pp.* 148–159, *Jan.*, 1938.—A theory of the propagation of electromagnetic waves in the ionosphere is developed, in which the essential gaseous character of the ionic cloud is considered. The usual theory, in so far as it accounts for the agitational motions of the ions at all, regards them only as a damping factor. The present theory leads to conclusions concerning the propagation of waves in an arbitrary direction to the field essentially different from those which are derived from the Appleton-Hartree formulæ. **Erratum,** *ibid. p.* 388, *Feb.*, 1938. J. J. S.

**1348. Reflection Coefficients of Ionospheric Regions. E. V. Appleton and J. H. Piddington.** *Roy. Soc., Proc.* 164.1. *pp.* 467–476, *Feb.* 18, 1938.—Experiments on the radio sounding of the ionosphere are described which give no support to the supposed existence of permanent highly reflecting regions at heights of 10 km. It is considered possible that the echoes of short delay noted by previous workers are due to atmospheric scattering patches of very low effective reflection coefficient. It is found that, after the normally recognised regions of the ionosphere, the radio reflecting centres in the atmosphere next in order of importance as regards radio echo production are transitory bursts of ionisation which occur at equivalent heights of from 80 to 160 km. Such bursts of ionisation are due to some cosmic agency which is usually effective throughout the whole of the day and night. AUTHORS.

*See also* Abstract 1110 and
759B. Measurement of Phase Difference between Harmonic Oscillations of Different Frequencies. E. Schegolev.
775B. Method of Measuring Velocity of Electromagnetic Waves. L. Mandelstam and N. Papalexi.
776B. Velocity of Radio Waves near the Earth's Surface. C. Viller and E. Schegolev.
1018B. Characteristics of the Ionosphere at Washington, D.C., November, 1937. T. R. Gilliland, S. S. Kirby, N. Smith and S. E. Reymer.
1042B. Technique of Short-Wave Measurement. R. Tamm.
1052B. Resonance Effects in a Non-Linear System with Two Degrees of Freedom. V. Migulin.

## PHOTOELECTRICITY.

**1349. Energy Distribution of Photoelectrons from Sodium. A. G. Hill.** *Phys. Rev.* 53. *pp.* 184–193, *Jan.* 15, 1938.—The total energy distribution functions for photoelectrons emitted from evaporated Na surfaces have been determined over a wide range of frequencies, by the use of the retarding potential method with concentric spherical electrodes. Theoretical energy distribution curves have been computed assuming an image field at the surface and following the general theory of Mitchell. It is shown that the theory does not fully account for the experimental results. The discrepancy can be accounted for by assuming a selective transmitting surface field with a transmission maximum at 0·5 eV. The spectral distribution function for the image field has also been computed and compared with the experimental data. Again the agreement is not satisfactory and is

only partly corrected by the use of the selective transmission barrier. It is concluded that the frequency dependence of the quantum absorption probability and the energy dependence of the barrier transmission probability differ from the image field predictions. This discrepancy is probably not caused by lack of refinements in the theory, but by the practical impossibility of producing an " ideal " surface of Na. AUTHOR.

**1350. Blocking-Layer Photoelectric Effect of Cæsium Oxide. H. Teichmann.** *Phil. Mag.* 25. *pp.* 269–273, *Feb.*, 1938.—Experiments are described which indicate that in composite Cs-O photo-sensitive kathodes blocking-layer effects are present in the intermediate layers, electrons being there liberated and migrating to the outer surface, whence they are set free by the external photoelectric effect. [See Abstract 3915 (1932).] D. H. F.

**1351. Effect of Mixed Light on Emission Photo-Cells. S. Petralia.** *N. Cimento*, 14. *pp.* 411–418, *Nov.*, 1937.—When lights of two different colours are incident on an emission photo-cell, the resultant effect is less than the sum of the separate effects due to each light acting alone. The author has studied this phenomenon in the case of both vacuum and gasfilled cells and gives the results obtained with white light and light filtered through colour screens. For filters which cut out the long-wave part of the spectrum the photo-current may be greater when the light passes through the filter than when it is allowed to fall on the photo-cell unfiltered. J. W. T. W.

***1352. Photoelectric Cell Circuit with a Logarithmic Response. J. Russell.** *Kodak Research Lab., Comm. No.* 640. *Rev. Sci. Instruments*, 8. *pp.* 495–496, *Dec.*, 1937.—It is shown that a simple arrangement of triode and photoelectric cell gives a plate current variation which is proportional to the logarithm of the light intensity and that the logarithmic character does not depend on the structural parameters of the tube. For this reason, it may have value in the construction of special optical instruments. AUTHOR.

**1353. Sensitisation of Transparent Compound Photo-Kathodes. P. Görlich.** *Zeits. f. techn. Physik*, 18. 11. *pp.* 460–462, 1937.—The sensitising effect of $O_2$ on transparent photo-kathodes of the type Sb-M or Bi-M, where M is an alkali metal, is investigated. A displacement of the long-wave maximum is observed, but not in all cases. Some of the sensitised kathodes exhibit two long-wave maxima. Thick kathodes of the type Sb-M or Bi-M are found to give the same spectral distribution as to the transparent kathodes, but the photoelectric currents are about 10 times smaller for the former than for the latter. L. A. W.

**1354. Photo-Kathodes in Contact. P. Görlich.** *Phil. Mag.* 25. *pp.* 256–259, *Feb.*, 1938.—Continuing previous work [see Abstract 3545 (1937)] the author investigates transparent unsensitised kathodes of the types Sb-M and Bi-M, where M is Cs, Rb, K, Na or Li. He finds that the selective maxima lie between 400 and 460 m$\mu$, independent of which alkali metal is used. With Rb-Sb and Cs-Sb layers the influence of angle of incidence is investigated at angles of 20°, 30° and 60°. With the electric vector parallel and perpendicular to the plane of incidence a sharp maximum is found as with unpolarised light, but stronger in the first case. L. A. W.

**1355. " Drift Effect " in Selenium Photovoltaic Cells. E. Elvegård, S. Lindroth and E. Larsson.** *J.O.S.A.* 28. *pp.* 33–35, *Feb.*, 1938.—The photo-current in a selenium photovoltaic cell varies with time,

even if constant conditions be maintained. This variation consists either in a decrease or an increase of current, the current approaching a constant value in the course of about 10 min. Whether the initial change of current is a decrease or an increase seems to be independent of the particular type of cell but is determined by the wave-length of the incident radiation and possibly also in certain cases by the temperature of the cell. If the cell is exposed to light from incandescent lamps, the effect is dependent on the temperature and will vanish at a certain temperature. The phenomenon is not an effect of fatigue; a more suitable name for it would be "initial effect". AUTHORS.

**1356. Stationary Photoelectric Primary and Secondary Currents in Crystals, particularly in KH-KBr Mixed Crystals. R. Hilsch and R. W. Pohl.** *Zeits. f. Physik*, 108. 1–2. *pp.* 55–84, 1937.—After a *résumé* of the theory of the primary current in insulating crystals, the considerations are extended to crystals with electrolytic conductivity in the dark. It is then pointed out that electronic conductivity in the dark leads to the production of a secondary photoelectric current and a quantitative theory of photoelectric currents in "mixed conductors" (*i.e.*, crystals showing both electrolytic and electronic conduction in the dark) is developed. In the limiting case of saturation the theory shows that saturation is obtainable for secondary as well as for primary currents. In the general case the electron losses are taken into account by an exponential law and a general equation for mixed conductors is deduced on the assumption of a practically linear field distribution in the illuminated crystal. As experimental basis for the theory an account is given of observations upon "model semiconductors" consisting of KH-KBr mixed crystals. L. A. W.

**1357. Theory of Photoconductivity. N. F. Mott.** *Phys. Soc., Proc.* 50. *pp.* 196–200, *March* 1, 1938.—It is shown on theoretical grounds that the primary photoelectric current in solids may be expected to tend to zero as the temperature is lowered; the presence of certain kinds of impurity may however prevent this. The theoretical conclusions are compared with the results of experiment. AUTHOR.

## PIEZOELECTRICITY.

**1358. Damping of Piezoelectric Vibrations. W. Bosshard and G. Busch.** *Zeits. f. Physik*, 108. 3–4. *pp.* 195–199, 1938.—This method is a development of that of H. Gockel [see Abstract 5317 (1936)] in which a crystal is excited at its resonance frequency and then, after definite time intervals, the amplitude of its vibration is measured and the decrement curve so constructed. In this method a quartz plate is excited at the resonance frequency and the piezoelectric charges, which are produced proportionately to its amplitude of vibration, used to obtain the decrement curve on the screen of a kathode-ray tube. The figure so obtained can be evaluated by superposing on it that from an alternating potential of known frequency. Damping is investigated at various temperatures—from 33° C. to − 133° C. It is found that the exponent $\alpha$ sinks linearly with temperature down to about − 100° C., where it becomes constant. At room-temperature the logarithmic decrement is $6{\cdot}8 \times 10^{-5}$ whilst below −100° C. it is $7{\cdot}7 \times 10^{-6}$. The results obtained by earlier workers are reviewed. G. G.

## THERMIONICS.

**1359. Thermionic Emission. E. W. B. Gill.** *Phil. Mag.* 24. *pp.* 1093–1103, *Dec.*, 1937.—Commercial triode valves are used at low currents and low voltages to obtain a formula of electron emission which will apply to all types of emitters, since Schottky's formula is found to fail for coated filaments. To obviate ionisation, the vacuum must be very good and tests are made for this before obtaining the current e.m.f. characteristics between the filament and the anode, and valve being used as a diode. For all the types of valves used, the formula $i = i_0 + a\sqrt{V}$ gives a very satisfactory account of emission at high voltages, $i_0$ and $a$ are constants of the valve and V is the voltage. The theory suggested, is that just round the filament there is a current density which remains constant and the emission adjusts itself to maintain this state of affairs, however many electrons may be removed by external agencies. This also accounts for the deviation from the formula at low voltages, because electrons are then only removed from the outer layers leaving a reverse field inside due to the electron space charge. H. M. B.

**1360. Influence of Crystal Lattice on Thermionic Emission. B. Mrowka.** *Zeits. f. techn. Physik*, 18. 12. *pp.* 572–574, 1937. *Phys. Zeits.* 38. *pp.* 998–1000, *Dec.* 1, 1937.—In the case of a single crystal it is suggested that the thermionic emission of a surface is dependent not only on the electronic energy of the crystal lattice but also on the crystalline orientation at the surface. [See following Abstract.] J. T.

**1361. Theory of Thermionic Emission. W. Schottky.** *Phys. Zeits.* 38. *pp.* 1024–1025, *Dec.* 1, 1937.—According to Mrowka's theory [see preceding Abstract] the thermionic emission of a surface is dependent on the crystalline orientation at the surface. This would also be expected from the usual thermodynamic theory. Mrowka's theory requires, however, that the usually accepted relationship between the saturation current and the electronic vapour pressure shall not hold. and on this basis a possible experimental test of the theory is suggested. J. T.

**1362. Characteristic of Thermionic Emission of Thoriated Molybdenum. P. Grauwin.** *Comptes Rendus*, 205. *pp.* 1375–1377, *Dec.* 27, 1937.—Mo filaments of 0·25 mm. and 0·3 mm. dia. containing $2{\cdot}6 \pm 0{\cdot}2\%$ of thorium oxide are used as kathodes, with a treble Ni anode, in tubes which are thoroughly degassed for over 30 hr. The tube characteristic is found to remain constant for several months. When the kathode is activated and deactivated several times, deterioration sets in, and maximum emission is no longer obtained. By plotting $i_0$ and $\sqrt{V}$ and extrapolating, the current at zero potential of the anode, for a definite temperature, is found. For temperatures below 1500° K, the curve $\log i - 2 \log T$ is plotted and Richardson's constants A and $\phi$ are deduced. The results for a complete monatomic layer of thorium oxide are: $A = 1{\cdot}0 \pm 0{\cdot}25$ ampere/cm$^{-2}$deg$^{-2}$ and $\phi = 2{\cdot}61 \pm 0{\cdot}01$ eV. A table is given for incomplete layers and results agree with known values. H. M. B.

**1363. Effect of Electron Bombardment on the Field Emission of Layered Kathodes. H. Mahl.** *Zeits. f. techn. Physik*, 18. 12. *pp.* 559–563, 1937. *Phys. Zeits.* 38. *pp.* 985–989, *Dec.* 1, 1937.—The effect of electron bombardment on the field emission for an Al-$Al_2O_3$-$Cs_2O$ kathode was examined. The formation of a surface potential of 10–40 V for an $Al_2O_3$ layer of thickness 2000 Å was shown directly. Investigation of the energy of emitted electrons showed that they were field electrons emitted partly from the lower surface of the Al layer and transmitted

without energy loss, and partly of electrons leaving the $Al_2O_3$ sheet with varying energies. Secondary field emission occurs at sensitive spots and is not spread evenly over the layer. The phenomenon is quite general and even occurs when the top layer is an insulator. F. C. C.

**1364. Rates of Deposition of Oxygen upon Tungsten. M. C. Johnson and A. F. Henson.** *Roy. Soc., Proc.* 165*A*. *pp.* 148–160, *March* 18, 1938.—An experiment is devised for investigating the passage of small and reproducible quantities of $O_2$ over a hot W filament whose surface purity can be ascertained by observation of its thermionic emission immediately before each admission of gas. The $O_2$ pressure at the filament surface is made to rise within a fraction of a second from a high vacuum to a transient value with a flat maximum of $10^{-3}$ to $10^{-4}$ mm. This enables the rate of primary adsorption to be isolated, and its dependence on gas pressure and on temperature to be determined, without the resulting monolayer becoming sufficiently dense to allow oxidation and appreciable thinning of the filament. The adsorption is traced by photographing the accompanying fall of electron emission by means of the oscillographic technique described in previous papers. Within a range of temperature and pressure such that evaporation is negligible and interaction between adsorbed particles is rare, the uncovered fraction of the surface decreases exponentially with time over a portion of each experiment. This enables a condensation constant to be obtained and its temperature dependence evaluated. The temperature coefficient which is found implies a heat of activation of 24,000 $\pm$ 3000 cal./mol. in the vicinity of 2200° Abs. The bearing on theories of activated adsorption is briefly discussed. [See also Abstracts 950 and 3789 (1937).] AUTHORS.

## THERMOELECTRICITY.

**1365. Thermoelectric Power, Thomson Coefficient and Thermal Conductivity of Nickel. A. Hammer.** *Ann. d. Physik*, 30. 8. *pp.* 728–744, *Dec.*, 1937.—The thermoelectric power of the couple Ni-Cu was measured up to 470° C., and the observed ferromagnetic anomaly is discussed. At room temperature and at the highest temperature the Thomson coefficient is less than zero; between these temperatures it is greater than zero. The variation of the thermal conductivity of Ni with temperature was shown to include an anomalous decrease in this quantity near the Curie point. [See also Abstracts 1618 and 1619 (1936)]. G. E. A.

**1366. Thermo-E.M.F.s of Supraconductors Near Their Transition Points. W. H. Keesom and C. J. Matthijs.** *K. Onnes Lab., Leiden, Comm. No.* 250*d*. *Physica*, 5. *pp.* 1–16, *Jan.*, 1938. *In English.*—Thermo-e.m.f.s of Pb against a silver alloy normal and against Sn, and of In against Pb were measured at temperatures obtainable with liquid He and with liquid $H_2$. The influence of a magnetic field was examined. The thermo-e.m.f. between two supraconductors is zero, also when a magnetic field, smaller than the threshold values for the two metals, is applied. The curve E (thermo-e.m.f.) versus T for temperatures above the transition point of one of the two metals is shifted by the application of a magnetic field, in connection with the shifting of the transition point. The curve $e$ (thermoelectric power) versus T is continuous at the transition point as well in a magnetic field as when no magnetic field is applied; $de/dT$, however, is discontinuous in both cases. In a region of about one or two degrees above the transition point, either in a magnetic field or not, $e$ varies with the (longitudinal) magnetic field. AUTHORS.